SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502
Department of CivilEngineering-Scheme of Instruction- (CBCS) effective from the Academic Year 2023-2024

M.Tech (PG) Specialization: ENVIRONMENTAL ENGINEERING

I **Semester**

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	EE11C	Advanced Water Treatment	3	1	0	4	4	40	60	100
PCC	EE12C	Air Pollution and Control	3	1	0	4	4	40	60	100
PCC	EE13C	Environmental Microbiology	3	1	0	4	4	40	60	100
PEC	EE14C	Programme Elective Course – I*	3	0	0	3	3	40	60	100
PEC	EE15C	Programme Elective Course – II*	3	0	0	3	3	40	60	100
PCC	EE11L	Environmental Engineering Lab - I	0	0	3	3	1.5	40	60	100
PCC	EE12L	Environmental Engineering Lab - II	0	0	3	3	1.5	40	60	100
MC	PG11C	Research Methodology and IPR	3	0	0	3	3	40	60	100
	Total		**18**	**3**	**6**	**27**	**24**	**320**	**480**	**800**

Course Code	List of Programme Elective Course I (EE14L)	Course Code	List of Programme Elective Course II (EE15L)
1	Environmental Chemistry	1	Climate Change
2	Environmental Quality and Pollution Monitoring Techniques	2	Noise Pollution and Control
3	Rural Water Supply and Onsite Sanitation System	3	Ground Water Contamination
4	Ecological Engineering and Stream Ecology	4	Transport of Water and Wastewater

*Students of a particular specialization of a department can also take Core/Elective courses of other specializations offered in the same department as Elective courses.

II Semester

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	EE21C	Advanced Wastewater Treatment	3	1	0	4	4	40	60	100
PCC	EE22C	Municipal Solid Waste Management	3	1	0	4	4	40	60	100
PEC	EE23C	Programme Elective Course – III*	3	0	0	3	3	40	60	100
PEC	EE24C	Programme Elective Course – IV*	3	0	0	3	3	40	60	100
PCC	EE21L	Environmental Modeling Lab	0	0	3	3	1.5	40	60	100
PCC	EE22L	Unit Operations and Processes laboratory	0	0	3	3	1.5	40	60	100
MC	PG21C	Value Added course**	2	0	2	4	3	100	-	100
PCC	MP21C	Mini Project with Seminar	1	1	0	2	2	100	-	100
	Total		**15**	**3**	**8**	**26**	**22**	**440**	**360**	**800**

Course Code	List of Programme Elective Courses III (EE23C)	Course Code	List of Programme Elective Courses IV (EE24C)
1	Industrial Wastewater Treatment	1	Environmental Impact Assessment
2	Urban Water Management	2	Sustainable Engineering and Technology
3	Hazardous Waste Management	3	Bioremediation
4	Wastewater Reclamation and Reuse	4	Environmental Legislation and Audit

** Value Added course - Cyber Security

III Semester

*Students of a particular specialization of a department can also take Core/Elective courses of other specializations offered in the same department as Elective courses.

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
OEC	PG31C	Open Elective Course ($MOOC_S$)	0	0	0	0	3	100	-	100
PCC	SE32S	Industrial/ Research Internship (Min of 4 Weeks)	0	0	0	0	3	100	-	100
PCC	DW31C	**Dissertation Work Phase-I**	0	0	24	24	12	40	60	100
	Total		**0**	**0**	**20**	**20**	**18**	**240**	**60**	**300**

	Open Electives (MOOCs)
1.	Business Analytics
2.	Industrial Safety
3.	Waste to Energy
4.	Cost Management of Engineering Projects
5.	Composite Materials
6.	Cyber security

IV Semester

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	DW41C	**Dissertation Work Phase-II and Viva-Voce**	0	0	20	20	10 + 06 = 16	40	60	100
	Total		**0**	**0**	**20**	**20**	**16**	**40**	**160**	**100**

*Students of a particular specialization of a department can also take Core/Elective courses of other specializations offered in the same department as Elective courses.

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502
Department of Civil Engineering-Scheme of Instruction- (CBCS) effective from the Academic Year 2023-2024

M.Tech (PG) Specialization: GEOTECHNICAL ENGINEERING

I Semester

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	GE11C	Advanced Soil Mechanics	3	1	0	4	4	40	60	100
PCC	GE12C	Advanced Foundation Engineering	3	1	0	4	4	40	60	100
PCC	GE13C	Earth Retaining Structures	3	1	0	4	4	40	60	100
PEC	GE14C	Programme Elective- I	3	0	0	3	3	40	60	100
PEC	GE15C	Programme Elective- II	3	0	0	3	3	40	60	100
PCC	GE11L	Geotechnical Engineering Lab - 1	0	0	3	3	1.5	40	60	100
PCC	GE12L	Geotechnical Engineering Lab - 2	0	0	3	3	1.5	40	60	100
MC	PG11C	Research Methodology and IPR	3	0	0	3	3	40	60	100
	Total		**18**	**3**	**6**	**27**	**24**	**320**	**480**	**800**

Course Code	List of Programme Elective Course I (GE14C)	Course Code	List of Programme Elective Course II (GE15C)
1	Soil Structure Interaction	1	Earth & Rockfill Dams
2	Ground Improvement Techniques	2	Environmental Geotechnology
3	Pavement Analysis and Design	3	Critical State Soil Mechanics
4	Physical and Constitutive Modelling in Geomechanics	4	Deep Foundations

*Students of a particular specialization of a department can also take Core/Elective courses of other specializations offered in the same department as Elective courses.

II Semester

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	GE21C	Dynamics of Soils and Foundations	3	1	0	4	4	40	60	100
PCC	GE22C	Subsurface Investigations and Instrumentation	3	1	0	4	4	40	60	100
PEC	GE23C	Programme Elective Course – III*	3	0	0	3	3	40	60	100
PEC	GE24C	Programme Elective Course – IV*	3	0	0	3	3	40	60	100
PCC	GE21L	Sub Soil Exploration Lab	0	0	3	3	1.5	40	60	100
PCC	GE22L	Numerical Analysis Lab	0	0	3	3	1.5	40	60	100
MC	PG21C	Value Added course**	2	0	2	4	3	100	-	100
PCC	MP21C	Mini Project with Seminar	1	1	0	2	2	100	-	100
	Total		**15**	**3**	**8**	**26**	**22**	**440**	**360**	**800**

Course Code	List of Programme Elective Courses III (GE23C)	Course Code	List of Programme Elective Courses IV (GE24C)
1	Marine Geotechnics	1	Design of underground excavations
2	Computational Geomechanics	2	Foundation on Expansive Soils
3	Engineering rock mechanics	3	Stability Analysis of Slopes
4	Geotechnical Earthquake Engineering	4	Foundations on Weak Rocks

** Value Added course - Cyber Security

III Semester

*Students of a particular specialization of a department can also take Core/Elective courses of other specializations offered in the same department as Elective courses.

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
OEC	PG31C	Open Elective Course ($MOOC_S$)	0	0	0	0	3	100	-	100
PCC	SE32S	Industrial/ Research Internship (Min of 4 Weeks)	0	0	0	0	3	100	-	100
PCC	DW31C	**Dissertation Work Phase-I**	0	0	24	24	12	40	60	100
	Total		**0**	**0**	**20**	**20**	**18**	**240**	**60**	**300**

	Open Electives (MOOCs)
1.	Business Analytics
2.	Industrial Safety
3.	Waste to Energy
4.	Cost Management of Engineering Projects
5.	Composite Materials
6.	Cyber security

IV Semester

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	DW41C	**Dissertation Work Phase-II and Viva-Voce**	0	0	20	20	10 + 06 = 16	40	60	100
	Total		**0**	**0**	**20**	**20**	**16**	**40**	**160**	**100**

*Students of a particular specialization of a department can also take Core/Elective courses of other specializations offered in the same department as Elective courses.

Department of Civil Engineering-Scheme of Instruction- (CBCS) effective from the Academic Year 2023-2024

M.Tech (PG) Specialization: WATER RESOURSE ENGINEERING

I **Semester**

Category	Course	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	WR11C	Advanced Fluid Mechanics	3	1	0	4	4	40	60	100
PCC	WR12C	Free Surface Flows	3	1	0	4	4	40	60	100
PCC	WR13C	Watershed management and Modelling	3	1	0	4	4	40	60	100
PEC	WR14C	Programme Elective- I*	3	0	0	3	3	40	60	100
PEC	WR15C	Programme Elective- II*	3	0	0	3	3	40	60	100
PCC	WR11L	Advanced Fluid Mechanics Lab	0	0	3	3	1.5	40	60	100
PCC	WR12L	Advanced Hydrology Lab	0	0	3	3	1.5	40	60	100
MC	PG11C	Research Methodology and IPR	3	0	0	3	3	40	60	100
	Total		**18**	**3**	**6**	**27**	**24**	**320**	**480**	**800**

Course Code	List of Programme Elective Course I (WR14C)	Course Code	List of Programme Elective Course II (WR15C)
1	Fluvial Hydraulics	1	Water Resources System Planning
2	Hydraulic Structures	2	Irrigation and Drainage
3	Systems Engineering	3	Water Power Engineering
4	Hydraulic Modeling and Experimental techniques	4	Urban Hydrology

*Students of a particular specialization of a department can also take Core/Elective courses of other specializations offered in the same department as Elective courses.

II Semester

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	WR21C	Advanced Hydrology	3	1	0	4	4	40	60	100
PCC	WR22C	Groundwater Engineering	3	1	0	4	4	40	60	100
PEC	WR23C	Programme Elective Course – III*	3	0	0	3	3	40	60	100
PEC	WR24C	Programme Elective Course – IV*	3	0	0	3	3	40	60	100
PCC	WR21L	Computational Fluid Dynamics Lab	0	0	3	3	1.5	40	60	100
PCC	WR22L	Open Chanel Flow Lab	0	0	3	3	1.5	40	60	100
MC	PG21C	Value Added course**	2	0	2	4	3	100	-	100
PCC	MP21C	Mini Project with Seminar	1	1	0	2	2	100	-	100
	Total		**15**	**3**	**8**	**26**	**22**	**440**	**360**	**800**

Course Code	List of Programme Elective Courses III (WR23C)	Course Code	List of Programme Elective Courses IV (WR24C)
1	Computational Methods in Fluid Mechanics	1	Environmental Hydraulics
2	Theory and Applications of GIS	2	Advanced Numerical Analysis
3	Hydrogeology and Geophysical exploration of groundwater	3	River Water Management
4	Coastal Engineering	4	Theory of Seepage and groundwater movement

** Value Added course - Cyber Security

III Semester

*Students of a particular specialization of a department can also take Core/Elective courses of other specializations offered in the same department as Elective courses.

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
OEC	PG31C	Open Elective Course ($MOOC_S$)	0	0	0	0	3	100	-	100
PCC	SE32S	Industrial/ Research Internship (Min of 4 Weeks)	0	0	0	0	3	100	-	100
PCC	DW31C	**Dissertation Work Phase-I**	0	0	24	24	12	40	60	100
	Total		**0**	**0**	**20**	**20**	**18**	**240**	**60**	**300**

	Open Electives (MOOCs)
1.	Business Analytics
2.	Industrial Safety
3.	Waste to Energy
4.	Cost Management of Engineering Projects
5.	Composite Materials
6.	Cyber security

IV Semester

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	DW41C	**Dissertation Work Phase-II and Viva-Voce**	0	0	20	20	10 + 06 = 16	40	60	100
	Total		**0**	**0**	**20**	**20**	**16**	**40**	**160**	**100**

Department of Civil Engineering-Scheme of Instruction- (CBCS) effective from the Academic Year 2023-2024

*Students of a particular specialization of a department can also take Core/Elective courses of other specializations offered in the same department as Elective courses.

M.Tech (PG) Specialization: STRUCTURAL ENGINEERING

I Semester

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	SE11C	Advanced Structural Analysis	3	1	0	4	4	40	60	100
PCC	SE12C	Advanced Solid Mechanics	3	1	0	4	4	40	60	100
PCC	SE13C	Design of Pre-stressed Concrete Structures	3	1	0	4	4	40	60	100
PEC	SE14C	Programme Elective- I	3	0	0	3	3	40	60	100
PEC	SE15C	Programme Elective- II	3	0	0	3	3	40	60	100
PCC	SE11L	Structural Design Lab	0	0	3	3	1.5	40	60	100
PCC	SE12L	Advanced Solid Mechanics Lab	0	0	3	3	1.5	40	60	100
MC	PG11C	Research Methodology and IPR	3	0	0	3	3	40	60	100
	Total		**18**	**3**	**6**	**27**	**24**	**320**	**480**	**800**

Course Code	List of Programme Elective Course I (SE14C)	Course Code	List of Programme Elective Course II (SE15C)
1	Analytical and Numerical Methods for Structural Engineering	1	Structural Health Monitoring
2	Theory and Applications of Cement Composites	2	Quality Control and Safety Management
3	Theory of Structural Stability	3	Maintenance and Rehabilitation of Structures
4	Advanced Steel Design	4	Fracture Mechanics of Concrete Structures

II Semester

Category	Course	Course Title	Scheme of Instruction (Hours/Week)	No. of	Scheme of Evaluation

*Students of a particular specialization of a department can also take Core/Elective courses of other specializations offered in the same department as Elective courses.

	Code		Lecture	Tutorial	Practical	Total	Credits	Sessional Marks	Semester End Examination Marks	Total
PCC	SE21C	FEM in Structural Engineering	3	1	0	4	4	40	60	100
PCC	SE22C	Structural Dynamics	3	1	0	4	4	40	60	100
PEC	SE23C	Programme Elective Course – III	3	0	0	3	3	40	60	100
PEC	SE24C	Programme Elective Course - IV	3	0	0	3	3	40	60	100
PCC	SE21L	Model Testing Lab	0	0	3	3	1.5	40	60	100
PCC	SE22L	Numerical Analysis Lab	0	0	3	3	1.5	40	60	100
MC	PG21C	Value Added course	2	0	2	4	3	100	-	100
PCC	MP21C	Mini Project with Seminar	1	1	0	2	2	100	-	100
	Total		**15**	**3**	**8**	**26**	**22**	**440**	**360**	**800**

Course Code	List of Programme Elective Courses III (SE23L)	Course Code	List of Programme Elective Courses IV (SE24L)
1	Design of Plates and Shells	1	Design of Advanced Concrete Structures
2	Design of Bridges	2	Advanced Construction Techniques
3	Design of High Rise Structures	3	Low cost Housing Techniques
4	Design of Earthquake Resistant Structures	4	Design of Industrial Structure

** Value Added course - Cyber Security

III Semester

Category	Course	Course Title	Scheme of Instruction (Hours/Week)	No. of	Scheme of Evaluation

*Students of a particular specialization of a department can also take Core/Elective courses of other specializations offered in the same department as Elective courses.

	Code		Lecture	Tutorial	Practical	Total	Credits	Sessional Marks	Semester End Examination Marks	Total
OEC	PG31C	Open Elective Course ($MOOC_S$)	0	0	0	0	3	100	-	100
PCC	SE32S	Industrial/ Research Internship (Min of 4 Weeks)	0	0	0	0	3	100	-	100
PCC	DW31C	**Dissertation Work Phase-I**	0	0	24	24	12	40	60	100
	Total		**0**	**0**	**20**	**20**	**18**	**240**	**60**	**300**

IV Semester

	Open Electives (MOOCs)
1.	Business Analytics
2.	Industrial Safety
3.	Waste to Energy
4.	Cost Management of Engineering Projects
5.	Composite Materials
6.	Cyber security

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	DW41C	**Dissertation Work Phase-II and Viva-Voce**	0	0	20	20	10 + 06 = 16	40	60	100
	Total		**0**	**0**	**20**	**20**	**16**	**40**	**160**	**100**

*Students of a particular specialization of a department can also take Core/Elective courses of other specializations offered in the same department as Elective courses.



SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING

M.Tech Degree Program (CBCS)

Curriculum & Syllabi for Environmental Engineering

(w.e.f 2023-24)

MAY, 2023

EE11C ADVANCED WATER TREATMENT

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT –I

WATER QUALITY AND CRITERIA: Water quality criteria and standards for different uses-drinking, irrigation, industrial and construction. Water quality indices, physical, chemical and physicochemical unit operations and processes -Typical treatment flow sheet of surface and underground water.

AERATION: Aeration, solubility of gases-two film theory, aeration methods, design of different aeration systems-sprinkler, cascade and mechanical.

UNIT –II

SEDIMENTATION: Different types of settling, settling column analysis, settling velocity and design principles of sedimentation tank, Tube settlers.

COAGULATION AND FLOCCULATION: Theory and mechanism of chemical coagulation and flocculation, determination of optimum coagulant doses, Chemical feed system. Theory of flocculation – orthokinetic and perikinetic, G and Gt factor, Hydraulic and mechanical mixing arrangements, design of different types of flash mixing and flocculator units.

UNIT –III

FILTRATION : Theory of filtration, Filter media-characteristics, hydraulics of flow through porous media, slow sand filtration, rapid sand filtration, precoat filtration, direct filtration of water, their design, back washing of filters – design of backwash ,Operational and maintainence problems.

DISINFECTION : Mechanism of disinfection, Factors affecting the disinfection process. Common disinfectants.Chemistry of chlorination, Chlorine handling and dosing, Ozonation, U.V. Disinfection-design criteria.

UNIT –IV

OTHER TREATMENT METHODS:

Adsorption- Definition ,factors affecting adsorption, isotherms. Removal of taste and odour, colour, iron and manganese, fluorides,arsenic,nitrates and desalination of water.

INDUSTRIAL WATER TREATMENT: Boiler feed water-Softening , Ion – exchange and reverse osmosis, Water stabilization, process water for food processing industries.

UNIT –V

WATER PLANT WASTE MANAGEMENT: Need for sludge management, Characteristics and quantities of water processing sludges, Design of water – treatment sludge thickners.Application of pressure filtration and centrifugation for dewatering of sludges. Alum recovery practices. Ultimate disposal of dewatered sludges.

LAYOUT AND HYDRAULIC DESIGN OF WATER TREATMENT PLANTS

Reference Books :

1. Montgomery, water treatment principles and design, Johnwiley and sons, Newyork.
2. Warren Viessman, Jrand Mark J. Hammer, Water Supply and Pollution Control by Harper & Row Publishers, New York.

3.Hazard S. Peavy, Donald R. Rowe and George Tchobanoglous, (1985). Environmental Engineering, McGraw-Hill Book Company, New York.

4J.RWeber (1972), Physicochemical Processes for Water Quality Control,John Wiley and Sons,USA.

Course Outcomes

After completion of course students are

1. Able to assess water quality parameters and aeration methods of water treatment
2. Able to design primary sedimentation tank and clariflocculator
3. Able to plan and design suitable filtration units and disinfection methods for drinking water treatment
4. Capable of applying appropriate advanced water treatment techniques.
5. Able to manage water treatment plant sludges and carry hydraulic design of Water treatment plant.

EE12C AIR POLLUTION AND CONTROL

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT – I

GLOBAL EFFECTS: Acid Rains, Green house effect and Ozone layer depletion.

POLLUTION SOURCES: Anthropogenic and Natural sources of Air pollutants. Types of Air pollutants. Properties of Air pollutants-Particulates, Carbon monoxide, Oxides of sulphur, Nitrogen Oxides, Hydrocarbons.

AIR POLLUTION SAMPLING AND MEASUREMENT –Devices for sampling, Different sampling methods, Sampling of Particulate Matter and Sampling of stack gas. Analysis of air pollutants Sulphur Dioxide, Nitrogen Oxides, Carbon Monoxide, Oxidants and Ozone, Hydrocarbons, Particulate Matter.

UNIT – II

EFFECTS OF AIR POLLUTANTS:

Effects of Carbon monoxide, Particulate Matter, Sulphur Dioxide, Oxides of Nitrogen, Hydrocarbon and photochemical oxidants on human beings. Effects on vegetation - Necrosis, Epinasty, Abscission and Chlorosis. Effects of Arsenic, Fluorine and Lead on animals. Effects of Air pollutants on metals, building materials, paints, textiles, electrical Materials, paper, leather, rubber and economy.

UNIT – III

METEOROLOGICAL ASPECTS OF AIR POLLUTANT DISPERSION:

Wind direction and speed, Temperature, Atmospheric stability, mixing height, Precipitation, Humidity, Solar radiation, Visibility, Inversions and plume behavior. The Gaussian Dispersion Model, Diffusion coefficients, Box model and Puff model.

UNIT - IV

AIR POLLUTION CONTROL METHODS:

CONTROLL OF PARTICULATE MATTER-General methods of control - Zoning - Town planning. Control of particulate matter –Gravity settling chambers, Cyclones, Inertial seperators, scrubbers, bag- filter, Electrostatic Precipitators.

REMOVAL OF GASEOUS MATTER–Control of Sulphur Dioxide by Reinluft process and Westvaco process; Control of $NO_X$by combustion modification, post-flame treatment;VOCs control by adsorption, combustion, condensation and process modification.

BIOMONITORING AND PHYTOREMEDIATION.

UNIT - V

AIR QUALITY AND EMISSION STANDARDS – Ambient Air Quality Standards (2015)

AUTOMOBILE POLLUTION:

Sources, emissions from diesel and petrol engines, Bharat V standards, catalytic convertors, Management of automobile pollution.

AIR POLLUTION AND LEGISLATION: Air Pollution Control Act, 1981, and Environment (Protection) Act, 1986.

Reference Books :

1. Crawford, M (1976). Air Pollution Control Theory, McGraw-Hill, New York.
2. H.C.Perkins (1974). Air Pollution, Mc-Graw Hill, Tokyo.
3. Wark, Kenneth and Cecil F. Warner (1976). Air Pollution : Its Origin and Control, Dun-Dunnelley, New York.

Course Outcomes (COs)

After completion of course student can able to

1. Describe the global effects of air pollution, air pollutants characteristics and sampling methods of air pollutants.
2. Capable of recognizing the effects caused by different air pollutants on human beings, animals, plants and materials.

3. Apply the meteorological aspects of air pollutants dispersion in the different dispersion modeling.
4. Capable of applying advanced technologies to reduce air pollution.
5. To manage automobile pollution and evaluate their efficiency

EE13C ENVIRONMENTAL MICROBIOLOGY

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT – I

GENERAL: Importance of Microorganisms. Classification of Microorganisms based on nutrition and metabolic activity

PROCARYOTIC ANDEUCARYOTIC MICRO ORGANISMS:

BACTERIA: Distribution, cytology, forms, size, cell structure,chemical composition, metabolism and classification.

FUNGI : Classification, identification, terminology and cultivation, chemical composition

ALGAE : Classification, identification, culture media, metabolism,pigments.

HIGHER FORMS : Protozoa - identification, classification,metabolism,nutrition. Rotifers; crustaceans; worms and larvae.

UNIT – II

STUDY OF MICROORGANISMS: stains and staining.

STUDY OFMICROSCOPES: ordinary, dark field, reflectance and electron microscopes.

GROWTH PATTERN OF MICROORGANISMS: Growth curve, food-microorganism relationship, aerobic-anaerobic growth, temperature,types of culture media, inhibitory media, Fungi media, Algae media, Protozoa media and isolation of microorganisms.Estimation of bacterial numbers.

NUTRITIONAL REQUIREMENTS FOR GROWTH: Required elements, organic growth factor requirements, Carbon source, Nitrogen source, control of synthetic reaction, energy source and selective effect of nutrients.

CONTROL OF MICROORGANISMS: Pattern of death, heat, disinfection, oxidizing agents, surfactants, heavy metals, Antimetabolites and Antibiotics,and PH.

UNIT – III

QUANTATIVE MEASUREMENT OF GROWTH:

Measurement of usable substrate,Measurement of oxygen uptake, Measurement of biomass,relationships between X and S.

ENZYMES AND GENETICS : Enzymes - Nature of enzymes, mode of action, effect of temperature, pH, salts and heavy metals on enzyme activity; Colloidal nature of enzyme, extracellular and intracellular enzymes, hydrolytic enzymes, oxidation-reduction enzymes, classification of enzymes. Genetics.

MICROBIOLOGY OF WATER: Bacterial content of various types of water sources - water borne diseases, differentiation of fecal and non-fecal coli forms, M.P.N. and other microbiological tests on water.

UNIT – IV

MICROBIOLOGY OF WASTEWATER:Aerobic and anaerobic metabolism.

CENTRAL PATHWAYS OF METABOLISM:Embden Meyerhof pathway, Tricarboxylic Acid Cycle(TCA),Hexose Monophosphate (HMP) pathway,Entner-Douderoff pathway.

AEROBIC METABOLISM-Metabolism of carbohydrates, metabolism of proteins, metabolism of lipids, metabolism of nucleic acids, metabolism of hydrocarbons.

ANAEROBIC METABOLISM-Fermentation of sugars-Formation of pyruvate from Glyceraldehyde 3-phosphate, formation of lactic acid,Decarboxylation of pyruvate, Formation of butanediol, Formation of butyric acid and butanol, Formation of propionic acid,Formation of glycerol. Fermentation of non carbohydratesubstrates.Anaerobic digestion process.

UNIT – V

MICROBIOLOGY OF COMPOSTING:Microorganisms involved in composting process.

MICROBIOLOGY OF AIR: Types of microorganisms, Air-borne diseases, control of air-borne diseases.

SOIL MICROBIOLOGY: Types of microorganisms, distribution,Bioremediation.

References Books:

1. R.E.McKiney, (1977), Microbiology for Sanitary Engineers, McGraw Hill, New York.
2. Anthony F.Gaudy and Elizabeth T.Gaudy (1980), Microbiology for environmental scientists and engineersMcGraw Hill publishers,Tokyo.
3. Michael J.Pelczar,JR.Chan, E.C.S. and Noel R. Krieg (2004) ,Microbiology,McGraw Hill, Inc., New York.
4.Ralph Mitchel and JiDonguGu (2010).Environmental Microbiology.Johnwiley and sons.Canada.

Course Outcomes (COs)

After completion of course student can able to

1. Classify the different types of microorganisms and use microscope and cultures suitably.
2. Analyze microbial growth kinetics
3. Understand salient aspects of enzymatic relationships and microbiology of water, wastewater and soil
4. Apply microbiological principles in air pollution control and composting
5. Able to control air borne disease due to microorganisms in the air and able to carry out composting process

EE14C ENVIRONMENTAL CHEMISTRY

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT – I

REACTION KINETICS : The rate law – Order of reactions ,Zero and First order reactions, second order reactions, Pseudo first order reactions– half life and its relationship to the rate constant – Factors affecting rate of reactions.

RECTORS-BATCH, CONTINUOUS, PLUG FLOW, PROCESS SELECTION

Reactors- mass balance analysis- batch, completely mixed and plug flow reactors – process selection Solution equilibrium – Le Chatlier principle -Activity and activity coefficients –Ion activity coeffs – solubility of salts – oxidation-reduction reactions - complex formation, solubility product,LCD for solubility determination, Oxidation-Reduction equillibria.

UNIT – II

CHEMICAL THERMODYNAMICS AND EQUILIBRIUM: Heat and work-Energy-Enthalpy, Free energy and its relationship to the equilibrium constant, calculation of change free energy at standard and ambient conditions. Entropy, Free energy.

EQUILIBRIUM PROCESSES : Volatilization – Air – water equilibrium – Henry's constant with units for a gas dissolving in a liquid – Dimensionless Henrry's constant for species transferring from a liquid to a gas.

UNIT – III

ACID – BASE EQUILIBRIUM: Hydrogen ion concentration (pH) – acids and bases and their equilibrium constants, PC-PH diagram: Log concentration Diagram – The carbonate system, alkalinity, and buffering capacity – Hydrolysis of salts and gases.

CHEMISTRY OF ORGANICS: Major groups of organic compounds – Difference between organics and inorganics – Organic compounds generally encountered in industrial wastewater –

Biodegradable and non - biodegradable organics. Hydrocarbons, Alcohols, Aldehydes, ketones and Acids, Carbohydrates, detergents, fats of organics.

UNIT –IV

NUCLEAR CHEMISTRY-Atomicstructure-stable and radioactive nuclidesnuclear reactions-Nuclear Fission-Nuclear fusion-Effect of Radiation on man, safety of nuclear reactors.

SURFACE AND COLLOIDAL CHEMISTRY-Properties of colloids, environmental significance, colloidal dispersion in liquids and air, EDL Theory, destabilization of colloids, Adsorption at solid-liquid interfaces.

UNIT-V

TREATMENT OF COOLING WATER: Water stabilization, Langumuir saturation Index, Caldwell-Lawrence diagrams, water softening- Chemical precipitation ,split treatment and Ion exchange process.

BIOCHEMISTRY-Biodegradation of carbohydrates, protein, fats and oils, biochemical pathways, Energetics and bacterial growth, enzymes.

Reference Books :

1. Sawyer, C.N., P.L.Mc Carty, and G.F.Parkin, (1994). Chemistry for Environmental Engineering,McGraw Hill, New York.
2. De, A.K. (1994). Environmental Chemistry, Wiley Eastern Limited, New Delhi.
3. Warner Stumn and James J. Morgen (1996). Aquatic Chemistry, 3rd ed., Wiley-Interscience series of tests and monographs.
4. Larry D. Benefield and Joseph F. Judkins. Jr. and Barron L.Weand (1981). Process Chemistry for water and waste water treatment, Printice Hall Inc.

Course Outcomes (Cos)

After completion students are

1. Able to apply principles of reaction kinetics and solution equillibrium

2. Able to apply the enthalpy and its relation with equilibrium constant

3. Able to find acid base equilibrium constants and capable of classifying organic and inorganic compounds.

4. able to understand surface and nuclear chemistry processes

5. To understand principles of softening and biochemistry.

EE14C ENVIRONMENTAL QUALITY AND POLLUTION MONITORING TECHNIQUES

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

INTRODUCTION- Importance of Quantativemeasurements,Character of Environmental Engineering and science problems,standards methods of analysis, scope of a course in analysis of environmental samples, expression of results. Gravemetric methods for solids analysis in water and wastewater.

UNIT-II

TITRAMETRIC METHODS

Determination of acidity, alkalinity,hardness, chloride and residual chlorine.

UNIT-III

INSTRUMENTAL METHODS

Optical methods of analysis, electrical methods of analysis,chromatographic methods,AAS,UV-VIS. Material characterization techniques- SEM, TEM, XRD, FTIR, thermal analysis- working principles and applications. Determination of nitrogen and phosphate.

UNIT-IV

BIOLOGICAL METHODS AND MICROBIOLOGY

Biochemical oxygen demand MPN test for microbial pollution Plate counts Confirmatory test.

UNIT-V

AIR POLLUTION ANALYSIS

Sampling techniques for air pollution measurements, analysis of particulates like PM_{10}, $PM_{2.5}$, $PM_{1.0}$ and common chemical air pollutants like VOC, Hydrocarbons, oxides of nitrogen and sulphur.

Course Outcomes

After completion of course student can

1. Able to do the gravimetric methods for solids analysis
2. Able to apply the different titrametric methods for pollution monitoring
3. Able to use the different instrumental methods for pollution monitoring.
4. Able to apply the different biological methods for pollution monitoring
5. Able to use the different air analysis methods of pollution monitoring

Reference Books :

1.Chemistry for environmental engineering and science ,fifth edition, by clair N sawyer,PerrylMccarty and Gene F, Parkin.

EE14C RURAL WATER SUPPLY AND ONSITE SANITATION SYSTEMS

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

Rural Water Supply: Issues of rural water supply –Various techniques for rural water supply-merits- National rural drinking water program- rural water quality monitoring and surveillance-operation and maintenance of rural water supplies

UNIT-II

Low Cost Water Treatment: Introduction – Epidemiological aspects of water quality- methods for low cost water treatment - Specific contaminant removal systems for contaminants like nitrites ,fluoride and arsenic

UNIT-III

Rural Sanitation: Introduction to rural sanitation- Community and sanitary latrines - Planning of wastewater collection system in rural areas- Treatment and Disposal of wastewater - Compact and simple wastewater treatment units and systems in rural areas- stabilization ponds – Pit latrines-dry latrine-wet latrine-septic tanks - Imhoff tank- soak pits- low cost excreta disposal systems-Effluent disposal.

UNIT-IV

Industrial Hygiene And Sanitation: Occupational Hazards- Schools- Public Buildings-Hospitals- Eating establishments- Swimming pools – Cleanliness and maintenance and comfort-Industrial plant sanitation.

UNIT-V

Solid Waste Management: Disposal of Solid Wastes- Composting- land filling- incineration-Biogas plants - Rural health - Other specific issues and problems encountered in rural sanitation.

ANIMAL WASTE DISPOSAL

Sanitary way of dung storage. Bio-gas plants – Classification, operation and maintenance problems.

Reference:

1. Eulers, V.M., and Steel, E.W., Municipal and Rural Sanitation, 6th Ed., McGraw Hill Book Company, 1965

2. Park, J.E., and Park, K., Text Book of Preventive and Social Medicine, BanarsidasBhanot, 1972

3. Wright, F.B., Rural Water Supply and Sanitation, E. Robert Krieger Publishing Company, Huntington, New York, 1977

4. Juuti, P., Tapio S. K., and Vuorinen H., Environmental History of Water: Global Views on Community Water Supply and Sanitation, IWA Publishing (Intl Water Assoc), 2007

5.WB Mannual –onsite sanitation systems.

6.WHO Mannual

Course Outcomes

After completion of the course student can

1. Able to apply various techniques for rural water supply
2. Able to plan low cost water treatment methods for rural areas.
3. Able to understand the salient aspects of rural sanitation and design wastewater treatment units
4. Able to frame water sanitation plan for industry, hospitals, swimming pools and eating places.
5. Able to manage rural solid wastes and animal waste.

EE14C ECOLOGICAL ENGINEERING AND STREAM ECOLOGY

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

INTRODUCTION TO ECOSYSTEMS

Development and evolution of ecosystems – Principles and concepts – Energy flow and material cycling – productivity – Classification of ecotechnology – ecological engineering- Classification of systems – Structural and functional interactions of environmental systems – Mechanisms of steady-state maintenance in open and closed systems.

UNIT-II

MODELING AND ECOTECHNOLOGY

Modeling and ecotechnology – Classification of ecological models – Applications- Ecological economics- Self-organizing design and processes.

UNIT-III

FLUVIAL ECOSYSTEM

Introduction To Fluvial Ecosystems: Fluvial Ecosystem Diversity- The Water Cycle – Stream flow- Flow Variation- The Stream Channel- Sediments and their Transport- Fluvial Processes along the River Continuum

UNIT-IV

STREAM WATER CHEMISTRY

Dissolved Gases -Major Dissolved Constituents of River Water-Variability in ionic concentrations -The dissolved load -Chemical classification of river water-The Bicarbonate Buffer System-Influence of Chemical Factors on the Biota-Variation in ionic concentration-Salinization - Effects of acidity on stream ecosystems

UNIT-V

WATER QUALITY

Water quality models – Historical development – Non point source pollution- Mass balance equation – Streeter - Phelps Equation – Modification to Streeter – Phelps Equation – Waste load allocations – Dissolved oxygen in Rivers and estuaries; Lake Water Quality Models; Models for Nitrogen, Bacteria, Phosphate and toxicants - Ground Water Quality Modeling - Contaminant solute transport equation, Numerical methods- legislations for water quality.

Reference:

1. Tebutt T.H.Y., Principles of Water Quality Control, 5th Ed., Pergamon Press, 1998

2. Thomann V. R., and Mueller A. J., Principles of Surface Water Quality Modelling and Control, Prentice Hall, 1997

3. Welch, E.D., Ecological Effects of Wastewater, Cambridge University Press, 1992

4. Frank R. Spellman and Joanne Drinan, Stream Ecology and Self Purification: An Introduction, 2nd Ed., CRC Press, 2001

Course Outcomes

After completion of course student can able to

1. Understand concepts of ecology
2. Explain the different types of ecological models
3. Understand the fluvial ecosystem
4. Use aspects of water chemistry for stream ecology
5. Apply suitable models for water quality assessment.

EE15C CLIMATE CHANGE

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

Earth's Climate System: Introduction-Climate in the spotlight - The Earth's Climate Machine – Climate Classification - Global Wind Systems – Trade Winds and the Hadley Cell – The Westerlies - Cloud Formation and Monsoon Rains – Storms and Hurricanes – The Hydrological Cycle – Global Ocean Circulation – El Nino and its Effect - Solar Radiation –The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.

UNIT-II

Observed Changes And Its Causes: Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC –Evidences of Changes in Climate and Environment – on a Global Scale and in India – climate change modeling.

UNIT-III

Impacts Of Climate Change: Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions– Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

UNIT-IV

Climate Change Adaptation And Mitigation Measures: Adaptation Strategy/Options in various sectors – Water – Agriculture –- Infrastructure and Settlement including coastal zones – Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS)- Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.

UNIT-V

Clean Technology And Energy: Clean Development Mechanism –Carbon Trading- examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding.

Readings:

1. Anil Markandya , Climate Change and Sustainable Development: Prospects for Developing Countries, Routledge, 2002

2. Heal, G. M., Interpreting Sustainability, in Sustainability: Dynamics and Uncertainty, Kluwer Academic Publ., 1998

3. Jepma, C.J., and Munasinghe, M., Climate Change Policy – Facts, Issues and Analysis, Cambridge University Press, 1998

4. Munasinghe, M., Sustainable Energy Development: Issues and Policy in Energy, Environment and Economy: Asian Perspective, Kleindorfor P. R. et. al (ed.), Edward Elgar, 1996

5. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007

Course outcomes:

After completion of course student can able to

1. Identify factors influencing the global climate systems
2. Assess impacts of climate change on global, regional and local scales
3. Describe impacts of climate change on different sectors
4. Develop strategies for adaptation and mitigation measures
5. Identify clean technologies for sustainable development.

EE15C NOISE POLLUTION AND CONTROL

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT – I

ACOUSTICAL CONCEPTS : Nature of Sound - Sound propagation characteristics - Propagation of sound in air - Absorption of sound in air - Hearing mechanics - Measurement scale - Equal loudness contours.

NOISE CHARACTERISTICS AND SOURCES OF NOISE: Noise characterization - Sources of noise.

UNIT – II

MEASURING INSTRUMENT AND TECHNIQUES: Methodology of noise measurements - Sound level meter - Noise dose meter - Audiometer - Noise survey techniques - Vehicular noise measurement techniques - Aircraft noise measurement techniques - Sound power determination techniques - Techniques for characterization of acoustical materials.

UNIT – III

HEALTH EFFECT OF NOISE: Annoyance - Sleep disturbance - Effect of noise on task performance and cardio-vascular system - Effect of noise on speech communication - Noise induced hearing loss (NIHL) : Effect of continuous sounds - Hearing damage due to impulse sounds.

ENVIRONMENTAL NOISE MEASUREMENTS : Introduction - Traffic noise survey - Vehicular noise level - Domesticappliances noise - Industrial noise - Aircraft noise - Community noise - Shipboard noise - Impulse noise.

UNIT – IV

NOISE STANDARDS AND LIMITS : Introduction - Legal position in India - Environmental standards - Occupational / Industrial noise standards - Road vehicles noise standards - Noise vehicles noise standards - noise standards for construction equipment and domesticappliances - Impulse noise (Fireworks) exposure standards.

NOISE IMPACT ASSESSMENT STUDIES: Definition of the problem - Elements of environmental noise - Assessment - Fractionalization approach to impact assessment - Impact of vibration environments - Case study.

UNIT – V

NOISE CONTROL TECHNIQUES: Mechanism of noise generation - Control methodology - Noise control at source - Noise control along the path - Control on the receiver end.

NOISE STRATEGY: FUTURE GUIDELINES: Current trend - Noise control measures - Environmental noise management - Noise labeling - Diagnostics - Noise strategy - Problems for future investigations.

Reference Books:

1. S.P.Singal, (1999) Noise Pollution and Control, Narosa Publishing House, New Delhi.

2. Cunniff, P.F. (1977), Environmental Noise Pollution, Wiley, New York.

3. Thumann, A., and R.K.Miller (1986). Fundamentals of Noise Control Engineering, Prentice Hall, Englewood Cliffs, N.J.

Course Outcomes

After completion of course student can

1. Able to describe about the sound propagation and noise characteristics
2. Able to assess noise levels
3. Able to classify different types of noise and its effect on environment and human beings
4. Able to apply the noise standards and limits and carry noise impact assessment.
5. Able to plan suitable noise control technologies.

EE15C GROUND WATER CONTAMINATION

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

INTRODUCTION- The Hydrological cycle, Ground water Hydrology, Ground water contamination and Transport, Evolution of Ground water Information, Ground Water Remediation. Confined aquifer and unconfined aquifers.

UNIT-II

SOURCES AND TYPES OF GROUNDWATER CONTAMINATION

Introduction, Underground storage tanks, Landfills, surface Impoundments, waste Disposal Injection Wells, septic systems, Agricultural wastes, Land application and Minning, Radioactive Contaminants, Military sources of contamination, classification of organic compounds, Inorganic compounds in ground water.

UNIT-III

CONTAMINANT TRANSPORT MECHANICS

Introduction, Advection process, Diffusion and Dispersion processes, Mass Transport equations, one–Dimensional Models, Governing Flow and Transport Equations, Analytical Methods, Multi dimensional Methods, Tests for Dispersivity, Natural Gradient Field Tests for Dispersion.

UNIT-IV

CONTAMINATION FATE PROCESSES

Sorption and Desorption, Abiotic Fate process, Volatilization, Biodegradation, Evaluation of Fate processes.

MODELLING BIODEGRADATION AND NATURAL ATTENUATION

Kinetics and Rates of Biodegradation, Modeling Biodegradation, Biodegradation Models, Analytical Natural Attenuation Models, Numerical Natural Attenuation Models, Field Applications.

UNIT-V

GROUND WATER REMEDIATION ALTERNATIVES

Remediation Methods, Remedial Alternatives, Containment Methods for source control, Hydraulic controls and pump and treat systems, Bioremediation, soil vapour Extraction systems, Remediating NAPL sites, Emerging Remediation Technologies.

Reference Books :

1.PhilipB.Bedient, Hanadi.s, J.charles (1994).Ground water contamination transport and remediation, PTR Prentice Hall.

2.Geo Environmental Engineering(2004),HariD.Sharma and Krishna Reddy, John wiley and sons.

Course Outcomes

After completion of course student can

1. Able to describe the fundamentals of ground water hydrology
2. Able to understand the sources and types of ground water contamination
3. Able to use models for contaminant transport
4. Able to understand contamination fate process and carry modeling of biodegradation rates
5. Able to apply different remediation methods for ground water.

EE15C TRANSPORT OF WATER AND WASTE WATER

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

TRANSPORT OF WATER: Water Storage and Transmission- Storage requirements, impounding reservoirs, intakes, pressure conduits, hydraulics, pumps and pumping units, capacity and selection of water pumps, economic design of pumps and economic design of gravity and pumping mains.

UNIT-II

MATERIALS FOR PIPES: Specification for pipes, pipe appurtenances, types of loads and stresses, water hammer, causes and prevention, control devices.

DISTRIBUTION SYSTEMS : Principles of design, analysis of distribution networks, Hardy Cross, equivalent pipe and Newton Raphson methods, computer applications in distributions network analysis, optimal design of networks, maintenance of distribution systems, methods of control and prevention of corrosion, storage, distribution and balancing reservoirs.

UNIT-III

TRANSPORT OF WASTEWATER

Sanitary Sewerage: Sanitation technology selection - sanitary sewage flow estimation - sanitary sewer materials - hydraulics of flow in sanitary sewers - partial flows - sewer design - sewer layouts, Concept of model based design - hydraulic fundamentals of design models - Basic properties and model formulations for the design of wastewater of collection system - transitions in flow of sewage.

UNIT-IV

STORM DRAINAGE-Basic philosophy in storm drainage - drainage layouts - storm runoff estimation - rainfall data analysis - hydraulics of flow in storm water drains - storm water drain materials and sections - design of storm drains - storm water inlets.

UNIT-V

OPERATION & MAINTENANCE: Maintenance requirements of sanitary sewerage and storm drainage systems - manpower requirement - equipment requirement; preventive maintenance - monitoring safety requirements-corrosion in sewers - prevention and control - Specific problems related to waste water pumping.

Text Books :

1. Hazard S. Peavy, Donald R. Rowe and George Tchobanoglous, (1985). Environmental Engineering, McGraw-Hill Book Company, New York.
2. Warren Viessman, Jr. and Mark J. Hammer (1985). Water Supply and Pollution Control, Harper and Row, Publishers, New York.
3. Sincero and Sincero (1996), Environmental Engineering, Prentice hall, Michigan university.

Course Outcomes (COs)

After completion of course student is

1. Capable of understanding the fundamentals of fluid flow
2. Able to analyze distribution system and design balancing reservoirs.
3. Capable of designing waste water collection system
4. Can able to design the storm drainage system
5. Can able to carry out maintenance of storm and sewerage drainage systems.

EE11L ENVIRONMENTAL ENGINEERING LAB - I

P / week : 3 Hrs | Sessional Marks : 40

University Exam : 3 Hrs | End Exam Marks : 60

Water and Air Analysis

1. (a) Determination of Colour
   (b) Determination of Turbidity
   (c) Determination of pH
   (d) Determination of Temperature and Odour

2. (a) Determination of Total Solids, Dissolved Solids, Suspended Solids.
   (b) Determination of Total Volatile and Fixed Solids.
   (c) Determination of Electrical Conductivity
3. (a) Determination of Total Acidity
   (b) Determination of Total Alkalinity
   (c) Determination of Dissolved oxygen
4. (a) Determination of Total Hardness
   (b) Determination of Chlorides
   (c) Determination of Sulphates
5. Determination of Residual chlorine content
6. Determination of MPN Index:

Presumptive Test, Confirmation Test, Completed Test, Grams Staining Technique

7. Demonstration of Ambient air quality measurement using High Volume Sampler.

   Analysis – SPM, NO_x, RSPM, SO_x.

Course Outcomes (COs)

After completion of the course the student will :

- Use standard methods for assessment for water quality
- Use statistical principles to analyze and interpret laboratory results
- Communicate effectively either through written or oral

EE12L ENVIRONMENTAL ENGINEERING Lab – II (Practical)

P / week : 3 Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

Wastewater and Solid waste Analysis

1. Determination of Total solids,Total suspended solids and Total Dissolved solids
2. Determination of settleable solids
3. Determination of BOD - Evaluation of Kinematic constants.
4. Determination of COD – Open Reflux Method, Block digester method, Colorimetric method and Titrimetric analysis.
5. Determination of Nitrates, TotalKjeldal Nitrogen, Ammonia and Nitrites.
6. Determination of Phosphates
5. Determination of Sulphates.
6. Demonstration of Rotating Biological Contactor
7. Analysis of Municipal Solid Waste – Component, Physical and Chemical Analysis.

Course Outcomes (COs)

After completion of the course the student will :

- Able to use standard methods to assess wastewater and municipal solid waste characteristics.
- Use effluent standards to analyze and interpret laboratory results
- Communicate effectively either through written or oral

EE21C ADVANCED WASTEWATER TREATMENT

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT – I

GENERAL:

CONSTITUENTS IN DOMESTIC WASTEWATER -BOD, COD, TOC, N AND P – biodegradability, nonbiodegradable organics and other inorganic. **TREATMENT PROCESS AND EFFLUENT DISPOSAL STANDARDS**. **PRIMARY TREATMENT**- Design of Screens, Grit chamber, Sedimentation tanks. **SUSPENDED GROWTH PROCESS:** Activated Sludge Process-ASP and its modifications,process design considerations, evaluation of Biokinetic parameter, Aeration, diffused aeration system.

UNIT – II

ATTACHED GROWTH PROCESS: Substrate removal in attached growth process-design of Trickling filter, rotating biological contactors.

PHOSPHOROUS REMOVAL: Biological phosphorus removal, chemical processes-chemical coagulation,precipitation and oxidation.Tracing phosphorous through treatment processes.

NITROGEN REMOVAL: Biological nitrification and denitrification, ammonia stripping, break point chlorination, and ion–exchange for ammonium (NH^{+}_{4}); Combined removal of nitrogen and phosphorus.Tracing nitrogen through treatment processes.

UNIT – III

ADVANCED PROCESSES:

Granular media filtration, micro screening, MSP like Reverse Osmosis, Electrodialysis, Ultra Filtration, Disinfection of waste water.

REMOVAL OF TOXIC COMPOUNDS AND REFRACTORY ORGANICS : Toxic and refractory organics – Detergents, PCB, phenol, Hydrogenated hydrocarbons, Pesticides and Aromatics. Removal by adsorption, chemical coagulation, Advanced Oxidation Process(AOP).

UNIT – IV

WASTE WATER RECYCLE, REUSE AND RECLAMATION

Ponds,Ditches,Lagoons,UASB,MBR,Constructed wetlands.Waste water Reuse Applications, Waste water Reclamation Technologies- Constituent Removal Technologies-Conventional waste water Treatment process flow diagrams for water Reclamation-Advanced waste water treatment process flow diagrams.

EMERGING CONTAMINANTS IN WASTE WATER- organic compounds and microorganism, Priority pollutants.

UNIT – V
WASTEWATER TREATMENT PLANT RESIDUE MANAGEMENT

Solids sources, characteristics and quantities-solid processing flow diagram-preliminary operations-Thickening-Digestion-condition-dewatering-Heat drying and composting-Thermal reduction-Reuse.

ENVIROMENTAL AND HYDRAULIC DESIGN OF WASTE WATER TREATMENT PLANTS

Stages of Design- data collection-site layout-Environmental and Hydraulic design.

Reference Books :

1. Metcalf and Eddy, Wastewater Engineering, Tata McGraw Hill Pub. Co.
2. M.J. Hammer, Water and Wastewater Technology, John Wiley and Sons.
3. Sincero Sr., A.P., and G.A.Sincero (1999), Environmental Engineering. A Design Approach Prentice-Hall of India Pvt. Ltd., New Delhi.

Course Outcomes (COs)

After completion of course student can able to

1. Identify and assess the characteristics of wastewater and hence impacts
2. Plan and design components of wastewater treatment plants
3. Understand the advanced process of wastewater treatment
4. Understand principles of wastewater reclamation and reuse
5. To manage sludge and do hydraulic design of wastewater treatment plant.

EE22C MUNICIPAL SOLID WASTE MANAGEMENT

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT – I

GENERATION AND CHARACTERISTICS OF SOLID WASTE:

Goals and objectives of solid waste management; Impacts of solid waste generation in a technological society, quantities of solid wastes, elements of solid waste management system, conservation of resources.

Solid waste generation sources; classification of solid waste; data on Indian City wastes; factors influencing generation of solid wastes; components characterization and analysis of solid wastes.

UNIT – II

ONSITE HANDLING, STORAGE AND PROCESSING OF SOLID WASTE:

Public health and aesthetics, onsite handling, methods used at residential and commercial sources; onsite storage dust bins; community containers, container locations; onsite processing methods.

COLLECTION, TRANSFER AND TRANSPORT OF SOLIDWASTE

Collection services, Point collection; frequency of collection, equipment and labour requirements; collection routes, transport means and methods and location of transfer stations.

Design of transfer stations.

UNIT – III

PROCESSING OF SOLID WASTE

Purpose of processing; processing techniques-Mechanical and chemical volume reduction, size reduction, component separation, drying and dewatering.

PROCESSING AND RECOVERY: Thermalrecovery of products – Incineration,pyrolysis and recovery of by-products,Air requirements for combustion-Incineration types-Refuse derived fuels (RDF), biological process and recovery ofconversion products-Composting – static pile, windrow,Vermi composting.

UNIT – IV

DISPOSAL OF SOLID WASTES: Open dumping – problems associated with open dumping sanitary landfills - site selection –design of landfills - Gas and leachate collection and control, ocean disposal of solid wastes. Application of GIS in landfill.

MUNICIPAL SOLID WASTE MANAGEMENT HANDLING RULES (2010).

UNIT – V

HAZARDOUS WASTE MANAGEMENT: Identification and classification of Hazardous wastes, storage, collection and treatment of Hazardous wastes, hazardous waste management rules, Management of Hospital wastes, introduction to e-waste management.

Reference Books:

1. WHO publication SWM for developing countries by frank flintoff**.**

2. Bhide, A.D, and Sundaresan, B.B. (1983) Solid Waste Management in Developing Countries, INSDOC, New Delhi.

3. Tchobanglous, G., Theisen, H. and Ehasin, R. (1996). Solid Waste Engineering Principles and Management Issues - McGraw Hill, Tokyo.

Course Outcomes (COs)

After completion of course students are

1.Able to assess the physical and chemical characteristics of municipal solid waste

2. capable of understanding the elements of solid waste management system.

3. Able to apply different processing methods in the management of municipal solid waste

4. Able to plan and design sanitary landfills for municipal solid waste disposal.

5. Able to apply hazardous waste management rules in handling hazardous waste.

EE23C INDUSTRIAL WASTEWATER TREATMENT

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT – I

INDUSTRIAL WASTE REGULATIONS

Industrial activity in India, Guidelines for siting of industries and industrial estates.Characteristics of industrial Wastewater.Differences between industrial wastes and domestic sewage.

IMPACT OF INDUSTRIAL WASTES ON ENVIRONMENT : Impact of acids and alkalies, suspended matter, organic matter (BOD), refractory organics, coloured matter, inorganic solids, heavy metals, foaming agents (detergents), nutrients, oil and greases, biological (pathogenic) wastes, thermal waters and nuclear wastes on the environment.

DISPOSAL STANDARDS OF DISTILLERY, TANNERY, PULP AND PAPER INDUSTRIES

UNIT – II

TREATMENT METHODOLOGY

Neutralization, Equalization, Proportioning, Sedimentation, Flotation , Screening, coagulation, Evaporation, Ion Exchange, Reverse Osmosis, Lagooning, High –rate aerobic treatment, Trickling filtration ,Rotating biological contactors,Anaerobic digestion system.

UNIT-III

OUTLINES OF MANUFACTURING PROCESSES, SOURCES, VOLUMES, CHARCTERISTICS, AND TREATMENT PROCESSES OF MAJOR INDUSTRIES:Sugarcane, distillery, tannery, pulp and paper mills, textile millindustry,fruit processing industry, steel plant industry

UNIT – IV

INDUSTRIAL WASTE MINIMIZATION PRACTICES:Volume reduction, strength reduction, process changes, equipment modifications, chemical substitution, segregation of wastes, equalization of wastes, by product recovery, proportioning wastes.

MANAGEMENT OF INDUSTRIAL SLUDGES: Sources of production of industrial sludges,anaerobic and aerobic digestion, vacuum filtration, elutriation, drying beds, Sludge Lagooning, wet combustion process, drying and incineration, centrifuging, sanitary landfill.

UNIT – V

CLEAN MANUFACTURE PROCESS-Basic concepts of clean technologies, Zero pollution industrial complexes, Introduction to ISO 14000,Life cycle Analysis, pollution pays policy, common effluent treatment plants.

Reference Books :

1. Nemerow, N.L. (1977). Liquid waste of Industry, Theories, Practices and Treatment, Addision-Wesly Publishing Company, London.
2. Mahajan, S.P. (1990). Pollution Control Processing Industries. Tata Mc–Graw – Hill Publishing Company Limited, New Delhi.
3. Rao, M.N.andA.K.Datta. (1979). Wastewater Treatment. Rational Methods of Design and Industrial Practices. Oxford and IBH Publishing Co., New Delhi.

Course Outcomes (COs)

1. Able to describe the concepts of industrial waste regulations.
2. Capable of applying the different preliminary, physical, chemical and biological treatment methods to the industrial waste water
3. Able to describe the characteristics of different types of industrial waste water,its manufacturing process and design units of treatment plant.
4. Capable of reducing the industrial waste and manage industrial sludge
5. Able to apply concepts of clean manufacturing process.

EE23C URBAN WATER MANAGEMENT

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

General introduction to urbanization and its effect on water cycle – urban hydrological cycle – trends in urbanisation – Effect of urbanisation on hydrology.

Urban Hydrological cycle – time of concentration – importance of short duration of rainfall and runoff data – methods of estimation of time of concentration for design of urban drainage systems.

UNIT-II

Master drainage plans – issues to be concentrated upon – typical content of an urban drainage master plan – interrelation between water resources investigation and urban planning processes – planning objectives – comprehensive planning – use of models in planning.

Basic approaches to urban drainage – runoff quantity and quality – wastewater and storm water reuse – major and minor systems.

UNIT-III

Elements of drainage systems – open channel – underground drains – appurtenances – pumping – source control. Storm water Analysis Calculation of runoff and peak – Design of storm water network systems.

UNIT-IV

Best Management Practices – Detention and retention facilities – Swales-constructed wetlands.

UNIT-V

Operation and maintenance of urban drainage system – interaction between storm water management and solid waste management, various model available for storm water management. Legal aspects

Readings:

1. Geiger W. F., J Marsalek, W. J. Rawls and F. C. Zuidema, Manual on Drainage in Urbanised area – 2 volumes, UNESCO, 1987

2. Hall M J , Urban Hydrology, Elsevier Applied Science Publisher, 1984

3. Stahre P and Urbonas B , Stormwater Detention for Drainage, Water Quality and CSO Management, Prentice Hall, 1990

4. Wanielista M P and Eaglin ,Hydrology – Quantity and Quality Analysis, Wiley and Sons, 1997

Course outcomes

After completion of course student can able to

1.Identify factors affecting urban hydrological cycle

2.Estimate urban water demand and urban storm water quantity

3. plan and design storm water control and disposal systems

4. develop integrated urban water management system

EE23C HAZARDOUS WASTE MANAGEMENT

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT- I

SOURCES, CLASSIFICATION AND REGULATORY FRAMEWORK

Types and Sources of hazardous wastes - Need for hazardous waste management ,Hazardous Wastes (Management and Handling) Rules, 1989

POLLUTION PREVENTION

Management strategies, TCLP, Life cycle analysis, volume reduction, toxicity reduction and recycling.

UNIT -II

PHYSICO CHEMICAL TREATMENT OF HAZARDOUS WASTE

Physico-chemical processes-air stripping, soil vapor extraction, carbon absorption, steam stripping, chemicaloxidation, supercritical fluids, membrane processes.

UNIT- III

BIOLOGICAL TREATMENT OF HAZARDOUS WASTE

Biological methods-Basic microbiology, engineeringfactors,growth kinetics, treatment systems ,conventional treatment, in situ bioremediation, slurry-phase treatment, solid-phase treatment, emerging technologies.

UNIT- IV

DISPOSAL METHODS

Thermal methods-regulations, combustion,liquid injection incinerators,solid waste incineration,storage and feed systems

Land disposal –landfill operation,siteselection,liner and leachate collection systems, cover systems,containment transport through landfill barriers,landfillstability,other types of land disposal facilities.

UNIT- V

CONTAINMENT

Objectives,passive contaminant control systems,surface water control technologies,ground water control,ground water control technologies,activesystems,other remedial measures.

REFERENCES:

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, "Integrated Solid Waste Management, Mc-Graw Hill International edition, New York, 1993.
2. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and Environmental Resources Management, Hazardous waste Management, Mc-Graw Hill International edition, New York, 2001.
3. CPHEEO, "Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation , Government of India, New Delhi, 2000.
4. Vesilind P.A., Worrell W and Reinhart, Solid waste Engineering, Thomson Learning Inc., Singapore, 2002.
5. Paul T Williams, Waste Treatment and Disposal, Wiley, 2005

OUTCOMES:

On completion of the course, the student is expected to be able to

1. Understand the characteristics of different types of hazardous wastes and the factors affecting variation
2. To plan suitable management strategies to handle hazardous waste
3. Apply different treatment methods in the management of hazardous waste
4. Apply concepts of thermal techniques for hazardous disposal and design landfill
5. Understand different surface and ground water control technologies

EE23C WASTE **WATER RECLAMATION AND REUSE**

L / week : 3Hrs	**Sessional Marks : 40**
University Exam : 3 Hrs	**End Exam Marks : 60**

UNIT - I

INTRODUCTION –The Role of Water Recycling in the Hydrological cycle, Wastewater Reuse Applications, Need for Water Reuse.

PUBLIC HEALTH AND ENVIRONMENTAL ISSUES IN WATER REUSE- Constituents in Reclaimed Water ,Public Health Issues, Environmental Issues, Environmental Issues.

UNIT - II

WASTEWATER RECLAMATION TECHNOLOGIES-Conventional wastewater Treatment process -Flow Diagrams for water Reclamation, Advanced Wastewater Treatment process flow diagrams, Performance expectations for water reclamation processes, Predicting the performance of Treatment process Combinations .

UNIT - III

STORAGE OF RECLAIMED WATER – Need for Storage, Meeting water quality discharge Requirements, Operations of Storage reservoirs, Problems involved with storage of Reclaimed Water.

AGRICULTURAL AND LANDSCAPE IRRIGATION EVALUATION OF IRRIGATION WATER QUALITY.

UNIT - IV

INDUSTRIAL WATER REUSE- Industrial water use, Cooling Tower Makeup water, water and salt balances in cooling Tower, Common water quality problems in cooling towers.

GROUND WATER RECHARGE WITH RECLAIMED WATER-Groundwater Recharge Methods, pretreatment Requirements for Groundwater Recharge ,Fate of Contaminants in Groundwater.

UNIT- V

PLANNED INDIRECT AND DIRECT POTABLE WATER REUSE-Planned Indirect Potable Water Reuse, Planned Direct Potable Water Reuse, Planned Potable Water Reuse Criteria.

CASE STUDIES IN WASTE WATER REUSE.

Reference:-

Metcalf and Eddy(2003), Wastewater Engineering Treatment and Reuse,Fourth Edition, Mc-Graw hill education.

Course Outcomes (COs)

After completion of course students are

1. Able to describe the applications of wastewater reuse and constituents in reclaimed water and its implications
2. Capable of planning and designing the advanced wastewater treatment processes.
3. Able to understand aspects of reclaimed water storage.
4. Capable of reusing industrial waste water to suitable applications
5. Capable of applying direct and Indirect Potable Water Reuse methods in the field

EE24C ENVIRONMENTAL IMPACT ASSESSMENTS

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

INTRODUCTION:

Impact of Development on Environment and Environmental Impact Assessment (EIA) and Environmental Impact Statement (EIS) – Objectives – Historical development – EIA Types – EIA in Project cycle- capability and limitations- Legal provisions on EIA.

UNIT-II

METHODOLOGIES:

Elements of EIA – Process screening, Methods of EIA- Strengths, weaknesses and applicability – appropriate methodology.

UNIT-III

PREDICTION AND ASSESSMENT

Socio Economic Impact – Prediction and Assessment of Impact on land, water, air and noise energy impact; Impact on flora and fauna; Mathematical models for prediction; Public participation – Reports – Exchange of Information – Post Audit – rapid EIA.

UNIT-IV

ENVIRONMENTAL MANAGEMENT PLAN:

Plan for mitigation of adverse impact on environment - options for mitigation of impact on water, air and land, flora and fauna; Addressing the issues related to the Project Affected People – Environment management Plan

UNIT-V

LIFE CYCLE ANALYSIS

Elements of Life Cycle Assessment **(**LCA) – Life Cycle Costing – Eco Labelling – Design for the Environment – International Environmental Standards – ISO 14001.

ENVIRONMENTAL AUDIT:

Environmental Audit and Environmental legislation objectives of Environmental Audit,Types of environmental Audit, Audit protocol, stages of Environmental audit, onsite activities,evaluation of Audit data and preparation of Audit report.

TEXT BOOKS

1. Anjaneyulu, Y. Environmental Impact Assessmentmethodologies B.S. Publications, Hyderabad 2002.
2. Canter, R.L. Environmental Impact Assessment, McGraw Hill Inc., NewDelhi,1996.
3. S.K. Shukla and P.R. Srinivastava, Concepts in Environmental Impact Analysis, Common Wealth Publishers, New Delhi, 1992.
4. Environmental science and Engineering by j. Glynn and Gary W. Hein Ke-Prentice Hall Publishers.

REFERENCE BOOKS

1. John G.Rau and David C Hooten (Ed)**.,**Environmental Impact Analysis Hand book, McGraw Hill Book Company, 1990.
2. Environmental Assessment Source book, Vol. II and III. The World Bank, Washington, D.C., 1991.
3. Judith Petts, Handbook of Environmental Impact Assessment Vol.I and II. Blackwell Sciencce, New York, 1999.
4. Environmental science and Engineering, by Suresh K.Dhaneja-S.K., Katania and sons Publication., New Delhi.

5. Environmental pollution and control, by Dr. H. S. Bhatia - Galgotia Publication (P) Ltd, Delhi.

6. P. Modak, C. Visvanathan and M. Parasnis, Cleaner Production Audit, Environmental System Reviews, Asian Institute of Technology, Bangkok, 1995.

Course Outcomes

After completion of course student can able to

1. Understand various aspects of EIA
2. Identify suitable methodologies for EIA study
3. Predict and assess the impact on environment
4. Prepare EMP
5. Understand LCA methodology and Environmental audit.

EE24C SUSTAINABLE ENGINEERING AND TECHNOLOGY

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

Unit I

ENERGY SOURCES

Introduction to energy, Environment and SustainableDevelopment; Energy transformation from source to services; Energy sources, sun as the sourceof energy; biological processes; photosynthesis; food chains, classification of energy sources,quality and concentration of energy sources; fossil fuel reserves - estimates, duration; theory of renewability, renewable resources; overview of global/ India's energy scenario.Non-renewable energy sources.

Unit II

ECOLOGICAL PRINCIPLES

Ecological principles, concept of ecosystems, ecosystem theories, energy resources and their inter-linkages, energy flow, the impacts of human activities on energy flow in major man-made ecosystems- agricultural, industrial and urban ecosystems.

Unit III

ENERGY SYSTEMS AND ENVIRONMENT

Environmental effects of energy extraction, conversion and use; sources of pollution from energy technologies (both renewable and non renewable); primary and secondary pollutants; consequence of pollution and population growth; air, water, soil, thermal, noise pollution -cause and effect; pollution control methods, sources and impacts; environmental laws on pollution control. Montrosal Protocol, Kyoto Protocol; Conference of Parties (COP); Clean Development Mechanism (CDM); Reducing Emissions from Deforestation and Degradation (REDD).

Unit IV

GREEN INNOVATION & SUSTAINABILITY

Criteria for choosing appropriate green energyTechnologies, life cycle cost; the emerging trends – process/product innovation-, technological/Environmental leap-frogging; Eco/green technologies for addressing the problems of Water,Energy, Health, Agriculture and Biodiversity- WEHAB (eco-restoration/ phyto-remediation,Ecological sanitation, renewable energy technologies,

industrial ecology, agro ecology and other Appropriate green technologies); design for sustainability (D4S).

Unit V

GREEN ENERGY AND SUSTAINABLE DEVELOPMENT

The inseparable linkages of life supporting systems, biodiversity and ecosystem services and their implications for sustainable development; global warming; greenhouse gas emissions, impacts, mitigation and adaptation ; future energy Systems- clean/green energy technologies; International agreements/conventions on energy and sustainability - United Nations Framework Convention on Climate Change (UNFCC); sustainable development.

References:

[1] Energy and EnvironmentSet: Mathematics of Decision Making, Loulou, Richard; Waaub, Jean-Philippe;Zaccour, Georges (Eds.), 2005, XVIII, 282 p. ISBN: 978-0-387-25351-0

[2] Energy and the Environment, 2nd Edition, John Wiley, 2006, ISBN:9780471172482; Authors: Ristinen, RobertA. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A., Publisher: Wiley, Location: New York, 2006.

[3] Energy and the Challenge of Sustainability, World Energy assessment, UNDP, N York, 2000.

[4] E H Thorndike, Energy & Environment: A Primer for Scientists and Engineers, Addison-Wesley PublishingCompany

[5] R Wilson & W J Jones, Energy, Ecology and the Environment, Academic Press Inc.

[6] D W Davis, Energy: Its Physical Impact on the Environment, John Wiley & Sons

[7] AKN Reddy, RH Williams, TB Johansson, Energy after Rio, Prospects and challenges, UNDP, United NationsPublications, New York, 1997.

[8] Global Energy Perspectives : Edited by NebojsaNakicenovic, ArnulfGrubler and Alan McDonald, CambridgeUniversity Press, 1998.

[9] Environment – A Policy Analysis for India, Tata McGraw Hill, 2000.Environmental Considerations in EnergyDevelopment, Asian Development Bank, Manila (1991).

[10] G. Masters (1991): Introduction to Environmental Engineering and Science, Prentice –Hall InternationalEditions.

[11] Fowler, J.M., Energy and the Environment, 2nd Ed. ,McGraw Hill, New York, 1984.

[12] Energy: Science, Policy, and the Pursuit of Sustainability by Robert Bent, ISBN13: 9781559639118, ISBN10:1559639113, 2002.

[13] New Approaches on Energy and the Environment: Policy Advice for the President, by Richard D. Morgenstern,ISBN13: 9781933115016, ISBN10: 1933115017, Publisher: Resources for the Future, Publication Date: February2005.

[14] http://unfccc.int/

[15] http://cdm.unfccc.int/

Course outcomes

After completion of course student can

1. Able to explain about the energy sources and sustainability
2. Able to understand the ecological principles
3. Capable of understanding consequences of pollution and its control methods.
4. Able to apply suitable the green energy systems
5. Capable of developing green sustainability

EE24C BIOREMEDIATION

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

Fundamental Aspects Of Environmental Microbiology:

Structure and Functions of Procaryotic Cells -Structure and Functions of Eucaryotic Cells

Taxonomy of Microorganisms: Bacteria- Algae, Fungi and Protozoa -Study of Microbial Structure -Light Microscopy -Dark-field and Phase-contrast Microscopy -Electron Microscopy - Environmental Significance of Bacteria, Fungi, and Algae -Microbial Metabolism, Growth and Biokinetics - Microbial Nutrition and Metabolism - Microbial Growth and Energy - Enzymes and Their structures - Biokinetic Models - Batch and Continuous Chemostat Studies - Determination of Biokinetic Parameters

UNIT-II

Microbiology Reactions:

Suspended Growth Reactors - Biofilm Reactors - Batch Reactors - Completely Stirred Tank Reactors - Plug Flow Reactors - Reactors in Series - Engineering Design of Reactors

UNIT-III

Bioflim Processes:

Trickling Filters and Biological Towers -Rotating Biological Contactors - Granular Media Filters - Fluidized-bed Reactors -Hybrid Biofllm Processes

UNIT-IV

Bioremediation For Soil Environment:

Environment of Soil Microorganisms -Soil Organic Matter and Characteristics -Soil Microorganisms Association with Plants - Pesticides and Microorganisms -Petroleum Hydrocarbons and Microorganisms -Industrial solvents and Microorganisms -Biotechnologies for Ex-Situ Remediation of Soil - Biotechnologies for in-Situ Remediation of Soil - Phytoremediation Technology for Soil Decontamination

UNIT-V

Biotreatment of Metals:

Microbial Transformation of Metals -Biological Treatment Technologies for Metals Remediation -Bioleaching and Biobenificiation -Bioaccumulation -Oxidation/Reduction Processes -Biological Methylation -Case studies

Emerging Environmental Biotechnologies:

Phytoremediation -Sequestering Carbon Dioxide -Biomonitoring -Application of Microbial Enzymes -Biomembrane Reactors

References:

1. Ergas, S.J., Chang, D.P.Y., Schreoder, E.D., and Eweis J.B., Bioremediation Principles , WCB/McGraw-Hill, 1998

2. Rittmann, B.E., and McCarty, P.L., Environmental Biotechnology : Principles and Applications, McGraw Hill, 2001

Course outcomes:

After completion of course student can able to

1.understand the fundamentals of environmental microbiology

2.design process for enhancing biodegradation

3.apply principles of bioremediation of soil environment

4.describe biotreatment of metals

5.identify ethical, environmental,societal and safety issues related to bioremediation.

EE24C ENVIRONMENTAL LEGISLATION AUDIT

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT I

INTRODUCTION

Common environmental laws-Role of judiciary in environmental protection-criminal law,common law-criminal procedure code-Indian penal code-fundamental rights and fundamental duties-international and national efforts at environmental protection –green funding and taxes-national environmental policies

UNIT II

WATER (P&CP) ACT, 1974 Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

UNIT III

AIR (P&CP) ACT, 1981 Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

UNIT IV

ENVIRONMENT (PROTECTION) ACT 1986 Genesis of the Act – delegation of powers – Role of Central Government - EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management - Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorisation – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards

UNIT V

OTHER TOPICS

Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC -Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases.

ENVIRONMENTAL AUDIT:

Environmental Audit and Environmental legislation objectives of Environmental Audit,Types of environmental Audit, Audit protocol, stages of Environmental audit, onsite activities,evaluation of Audit data and preparation of Audit report.

REFERENCES

1. CPCB "Pollution Control acts, Rules and Notifications issued there under "Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi, 1997.

2. Shyam Divan and Armin Roseneranz "Environmental law and policy in India "Oxford University Press, New Delhi, 2001.

3. GregerI.Megregor "Environmental law and enforcement", Lewis Publishers, London.

4. A. Singh and O.P. Ward Biodegradation and bioremediation, Springer-Verlag Berlin Heidelberg New York, 2004.

5. K.H. Baker and D.S. Herson, Bioremediation, McGraw-Hill, Inc., New York, 1994.

6. M. Alexander, Biodegradation and Bioremediation, Academic Press, 1999.

Course Outcomes:

After completion of course students are able to

1. Apply the different environmental laws and penal codes for environmental protection.
2. To take steps for the control of water pollution
3. Understand the salient features of air act
4. Describe the salient features of environmental act
5. Understand the salient features of Indian forest act, public liability act , public interest litigations and audit.

EE21L ENVIRONMENTAL MODELLING LABORATORY

P / week : 3 Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

Design of water supply pipe sections and networks using Software packages like EPANET – Design of Wastewater collection systems, integrated design of water and wastewater treatment plants by using appropriate free domain software packages. Modeling of Air pollutant dispersion using softwares.

Course Outcomes (COs)

1.Able to apply the application of computing techniques in the environmental engineering field.

2. capable of designing the water supply pipe sections and treatment plants using software packages

3. Able to do Modeling of air pollutant dispersion using software packages.

EE22L UNIT OPERATIONS AND PROCESSES LABORATORY

P / week : 3 Hrs	**Sessional Marks : 40**
University Exam : 3 Hrs	**End Exam Marks : 60**

LIST OF EXPERIMENTS

1. Jar test
2. Sedimentation column analysis
3. Studies on Filtration
4. Adsorption Studies
5. Adsorption studies/Kinetics
6. Activated sludge process
7. Trickling filter
8. Anaerobic Reactor systems (Demonstration)
9. Disinfection for Drinking water

REFERENCES:

1. Metcalf and Eddy. Inc. „Wastewater Engineering, Treatment, Disposal and Reuse, Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
2. Lee, C.C. and Shun dar Lin. Handbook of Environmental Engineering Calculations, McGraw Hill, New York, 1999.
3. Casey T.J., Unit Treatment Processes in Water and Wastewater Engineering, John Wileys Sons, London, 1993.
4. David W.Hendricks, „Water Treatment Unit Processes: Physical and Chemical", CRC Press, Boca Raton, 2006.

Course Outcome:

1. Able to conduct Treatability studies of water and wastewater treatment by various Unit Operations and Processes using laboratory scale models



SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING DEPARTMENT OF CIVIL ENGINEERING

M.Tech Degree Program (CBCS)

Curriculum & Syllabi for Geotechnical Engineering

(w.e.f 2023-24)

MAY, 2023

PROGRAMME OBJECTIVES

1. To make students learn the principles of soil and rock mechanics. Understand different problems associated with geotechnical engineering. Explain how to select design soil/rock parameters for Design purpose based on the subsurface exploration. Develop Analysis and Design procedure for various geotechnical structures.
2. Students should gain competency in the design of shallow/deep foundations, earth retaining Structures, embankment and earthen dams, underground structures. Can assess stability of slopes and apply preventive measures for stability.

PROGRAMME OUTCOMES (POs)

1. Students will learn soil and rock behaviour. Students will be able to perform various laboratory and in-situ tests on soil/rock to find out design parameters.
2. Students can design shallow/deep foundations, earth retaining structures, embankment and earthen dams, tunnel support systems for given site conditions.
3. Student can compute factor of safety to assess stability of slopes and apply preventive measures for stability.
4. Student can develop numerical models to estimate response of various geotechnical structures under different loadings.

GE11C ADVANCED SOIL MECHANICS

L / week	**: 3Hrs**	**Sessional Marks**	**: 40**
University Exam	**: 3 Hrs**	**End Exam Marks**	**: 60**

UNIT I

COMPRESSIBILITY OF SOILS: Consolidation theory (one, two, and three dimensional consolidation theories), consolidation in layered soil and consolidation for time dependent loading, determination of coefficient of consolidation (Casagrande method and Taylors method)

UNIT II

STRENGTH BEHAVIOUR OF SOILS: Mohr Circle of Stress; UU, CU, CD tests, drained and undrained behaviour of sand and clay, significance of pore pressure parameters; determination of shear strength of soil; Interpretation of triaxial test results.

UNIT III

STRESS PATH: Drained and undrained stress path; Stress path with respect to different initial state of the soil; Stress path for different practical situations.

UNIT IV

CRITICAL STATE SOIL MECHANICS: Critical state parameters; Critical state for normally consolidated and over consolidated soil; Significance of Roscoe and Hvorslev state boundary surface; drained and undrained plane. Critical void ratio; effect of dilation in sands; different dilation models.

UNIT V

ELASTIC AND PLASTIC DEFORMATIONS: Elastic wall; introduction to yielding and hardening; yield curve and yield surface, associated and non-associated flow rule.

References

1. Atkinson, J.H. and Bransby, P.L, The Mechanics of Soils: An introduction to Critical Soil Mechanics, McGraw Hill, 1978.
2. Atkinson J.H, An introduction to the Mechanics of soils and Foundation, McGraw- Hill Co., 1993.

3. Das, B.M., Advanced Soil Mechanics, Taylor and Francis, 2nd Edition, 1997.
4. Wood, D.M., Soil Behavior and Critical State Soil Mechanics, Cambridge University Press, 1990.
5. Craig, R.F., Soil Mechanics, Van Nostrand Reinhold Co. Ltd., 1987.
6. Terzaghi, K., and Peck, R.B., Soil Mechanics in Engineering Practice, John Wiley & Sons, 1967.
7. Lambe, T.W. and Whitman, R.V., Soil Mechanics, John Wiley & Sons, 1979.

Course Outcomes

The Students will be able to:

1. Aquire complete knowledge on Strength and Compressibility of soil mass
2. Aquire complete knowledge on Strength behaviour of soils
3. Understand importance of stress paths with respect to state of soils.
4. Understand mathematical models for solving different problems in soil mechanics using critical state frame work.
5. Visualize the concept of elastic and plastic deformation in soils.

GE12C ADVANCED FOUNDATION ENGINEERING

L / week	**: 3Hrs**	**Sessional Marks**	**: 40**
University Exam	**: 3 Hrs**	**End Exam Marks**	**: 60**

UNIT I

SHALLOW FOUNDATIONS: Requirements for Satisfactory Performance of Foundations, Methods of Estimating Bearing Capacity, Settlements of Footings and Rafts, Proportioning of individual and combined footings using IS code.

UNIT II

PILE FOUNDATIONS: Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations, Pile Group Capacity and Settlement, Negative Skin Friction of Piles, Pile Load Tests, Analytical Estimation of Load- Settlement Behaviour of Piles, Proportioning of Pile Foundations, Uplift Capacity of Piles.

UNIT III

WELL FOUNDATION: IS and IRC codal provisions, elastic theory and ultimate resistance methods

UNIT IV

FOUNDATIONS ON PROBLEMATIC SOILS: Foundations for collapsible and expansive soils

UNIT V

COFFER DAMS: Various Types, Analysis and Design of Foundations.

References

1. Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn, 1997.
2. Das B.M., Shallow Foundations: Bearing capacity and settlement, CRC Press, 1999.
3. Tomlinson M.J., Pile design and construction Practice, Chapman and Hall Publication, 1994.
4. Poulos, H. G. and Davis, F. H., "Pile Foundation Analysis and Design", Wiley and Sons. 1980

Course Outcomes

The Students will be able to:

1. Estimate bearing capacity of soil and proportion shallow foundations.
2. Estimate the load in piles and design the pile foundation.
3. Design well foundation as per codal provisions.
4. Design foundations on problematic soils
5. Analyze and design coffer dams.

GE13C EARTH RETAINING STRUCTURES

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks: 60**

UNIT I

EARTH PRESSURE: Rankine and Coulomb theories, active, passive and pressure at rest; concentrated surcharge above the back fill, earth pressure due to uniform surcharge, earth pressure of stratified backfills, saturated and partially saturated backfill.

UNIT II

RETAINING WALLS: Proportioning of retaining walls, stability of retaining walls, mechanically stabilized retaining walls/reinforced earth retaining walls

UNIT III

SHEET PILE WALL: Free earth system, fixed earth system

BULKHEADS: Bulkheads with free and fixed earth supports, equivalent beam method, Anchorage of bulkheads and resistance of anchor walls, spacing between bulkheads and anchor walls, resistance of anchor plates.

UNIT IV

BRACED EXCAVATIONS: Earth pressure against bracings in cuts, Heave of the bottom of cut in soft clays.

UNIT V

TUNNEL AND CONDUIT: Stress distribution around tunnels, Types of conduits, Load on projecting conduits; Arching and Open Cuts: Arching in soils.

References

1. Das, Braja M., "Principles of Foundation Engineering", PWS Publishing. 1998
2. Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn, 1997.

Course Outcomes (COs)

The students will be able to:

1. Develop ability to compute different conditions for soil and loading.
2. Design Retaining wall
3. Analyze sheet piles Bulkheads
4. Compute earth pressure and heaving in braced excavations
5. Compute the stresses in Tunnels, Conduits and Arching in open cuts.

GE14C SOIL STRUCTURE INTERACTIONS

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

.

UNIT I: Soil-Foundation Interaction: Introduction to soil-foundation interaction problems, Soil behaviour, Foundation behaviour, Interface behaviour, Scope of soil foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behaviour, Time dependent behavior.

UNIT II: Beam on Elastic Foundation- Soil Models: Infinite beam, Two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness.

UNIT III: Plate on Elastic Medium: Thin and thick plates, Analysis of finite plates, Numerical analysis of finite plates, simple solutions.

UNIT IV: Elastic Analysis of Pile: Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap.

UNIT V: Laterally Loaded Pile: Load deflection prediction for laterally loaded piles, Subgrade reaction and elastic analysis.

References

1. Selvadurai, A.P.S, Elastic Analysis of Soil-Foundation Interaction, Elsevier, 1979.
2. Poulos, H.G.,and Davis, E.H.,Pile Foundation Analysis and Design, John Wiley, 1980.
3. Scott, R.F., Foundation Analysis, Prentice Hall, 1981.
4. Structure Soil Interaction-State of Art Report, Institution of Structural Engineers,
5. ACI 336. (1988), Suggested Analysis and Design Procedures for combined footings and Mats, American Concrete Institute.

Course Outcomes

The students will be able to:

1. Comprehend soil foundation interaction concepts

2. Analyze soil models with beam on elastic foundation
3. Analyze soil models with plates on elastic medium
4. Analyze load distribution and settlement in piles using elastic analysis
5. Predict the deflections in laterally loaded piles using elastic analysis.

GE14C GROUND IMPROVEMENT TECHNIQUES

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT I

INTRODUCTION: situations where Ground Improvement becomes necessary

MECHANICAL MODIFICATION: Dynamic Compaction, Impact Loading, Compaction by Blasting, Vibro-Compaction; Pre-Compression, Stone Columns; Hydraulic Modification: Dewatering Systems, Preloading and Vertical Drains, Electro-Kinetic Dewatering

UNIT II

CHEMICAL MODIFICATION; Modification by admixtures, Stabilization Using Industrial Wastes, Grouting

UNIT III

THERMAL MODIFICATION: Ground Freezing And Thawing.

UNIT IV

SOIL REINFORCEMENT: Reinforced Earth, Basic Mechanism, Type of Reinforcements, Selection of Stabilization/Improvement of Ground using Geotextiles, Goegrid, Geomembranes, Geocells, Geonets, and Soil Nails.

UNIT V

APPLICATION OF SOIL REINFORCEMENT: Shallow foundations on reinforced earth, design of reinforced earth retaining walls, reinforced earth embankments structures, wall with reinforced backfill, analysis and design of shallow foundations on reinforced earth, road designs with geosynthetics.

References

1. Hausmann, M.R., Engineering Principles of Ground Modification, McGraw-Hill
2. International Editions, 1990.
3. Yonekura, R., Terashi, M. and Shibazaki, M. (Eds.), Grouting and Deep Mixing, A.A. Balkema, 1966.
4. Moseley, M.P., Ground Improvement, Blackie Academic & Professional, 1993.
5. Xanthakos, P.P., Abramson, L.W. and Bruce, D.A., Ground Control and Improvement, John Wiley & Sons, 1994.
6. Koerner, R. M., Designing with Geosynthetics, Prentice Hall Inc. 1998.
7. Shukla, S.K., Yin, Jian-Hua, “Fundamentals of Geosynthetic Engineering”, Taylor & Francis.

Course Outcomes

The students will be able to:

1. Assess the site or ground conditions and judge for adopting ground improvement techniques for a particular structure and site conditions.
2. Select suitable improvement techniques or stabilization methods for improving engineering properties of soils in shallow layers.
3. Select suitable reinforced earth methods for stabilizing soils in different applications.
4. Select suitable reinforced earth methods for stabilizing soils in deep layers.

GE14C PAVEMENT ANALYSIS AND DESIGN

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks: 60**

UNIT I

Philosophy of design of flexible and rigid pavements,

UNIT II

Analysis of pavements using different analytical methods,

UNIT III

Selection of pavement design input parameters – traffic loading and volume,

UNIT IV

Material characterization, drainage, failure criteria, reliability,

UNIT V

Design of flexible and rigid pavements using different methods, Comparison of different pavement design approaches, design of overlays and drainage system.

References:

1. Yang and H. Huang, Pavement Analysis and Design, Pearson Prentice Hall, 2004.
2. Yoder and Witzech, Pavement Design, McGraw-Hill, 1982.
3. Sharma and Sharma, Principles and Practice of Highway Engg., Asia Publishing House, 1980.
4. Teng, Functional Designing of Pavements, McGraw- Hill, 1980.

Course Outcomes (COs)

The students will be able to

1. Assess the factors affecting the performance of pavements.
2. Identify failure criteria and design flexible and rigid pavements.
3. Compare and select suitable pavement design approach, overlays, and design aspects.

GE14C PHYSICAL AND CONSTITUTIVE MODELLING IN GEOMECHANICS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks: 60**

UNIT I

ROLE OF CONSTITUTIVE MODELING: Importance of laboratory testing with relation to constitutive modeling; Elasticity: linear, quasi linear, anisotropic;

UNIT II

PLASTICITY BASICS: yield criteria, flow rule, plastic potential, hardening/softening; Rate Independent Plasticity: mohr-coulomb, nonlinear failure criteria, Drucker Prager, and cap models;

UNIT III

CRITICAL STATE SOIL MECHANICS: critical state concept, cam clay models, simulation of single element test using cam clay,

UNIT IV

CONSOLIDATION: drained and undrained triaxial test; Stress dilatancy theory;

UNIT V

WORK HARDENING PLASTICITY THEORY: formulation and implementation; Applications of elasto-plastic models; Special Topics: hypoelasticity-plasticity, disturbed state concept.

References

1. Hicher and Shao, “Constitutive Modeling of Soils and Rocks”, John Wiley. 2008
2. C.S. Desai and H. J. Siriwardane, “Constitutive Laws for Engineering Materials with
3. Emphasis on Geologic Materials”, Prentice-Hall, Inc., New Jersey. 1984
4. David M Potts and LidijaZdravkovic, “Finite Element Analysis in Geotechnical Engineering Theory and Application”, Thomas Telford. 1999
5. C.S. Desai, “Mechanics of Materials and Interfaces: The Disturbed State Concept”, CRC Press LLC. 2000

6. A.P.S. Selvadurai, M.J. Boulon, “Mechanics of Geomaterial Interfaces, Elsevier.

Course Outcomes

The students will be able to

1. Understand Stress strain models of elasticity of isotropic and anisotropic models.
2. Understand theory of plasticity and various yield criteria and flow rule.
3. Apply critical state concept to consolidation and triaxial soil behaviour.
4. Understand the application aspects of elasto plastic models.

GE15C EARTH AND ROCKFILL DAMS

L + T / week : 3Hrs Sessional Marks : 40

University Exam: 3 Hrs End Exam Marks: 60

UNIT – I
EMBANKMENT DAMS – BASIC CONSIDERATIONS
Selection of dam site – Choice of type of dam – Classification of embankment dams – Types of failures – Criteria for safe design – Foundation investigation – laboratory tests – Construction of earth dams – Quality control and instrumentation.

UNIT – II
SEEPAGE THEORY
Fundamentals of seepage flow – Kozney's solution – Anisotropic seepage – Top flow line – Flownet for earth dams – Seepage force and its effects – Control of seepage through embankment dams – Filter design – Drainage measures.

UNIT – III
FOUNDATION TREATMENT
Rock foundations – Alluvial foundations – Primary foundation – Clayey soils – Seepage containment – Upstream impervious blanket – Dam stream drainage.

UNIT – IV
STABILITY ANALYSIS
Critical stage & port pressures in earth dams – Stability analysis – Effective and total stress approach – Method of slices – Location of critical circle – Earthquake considerations.

UNIT – V
ROCKFILL DAMS
General characteristics – Materials – Foundations – Design of dam section – Drainage – Construction.

References
1. Earth and Earth Rock Dams by J.L. Sherard et al.
2. Earth and Rockfill Dams by Bharat Sigh and H.D. Sharma.
3. Development in Soil Mechanics – I edited by C.R. Scoott.

Course Outcomes:

The students will be able to

1. Understand the choice aspects for embankment construction.

2. Compete the seepage and suggest control measure seepage through embankment dams.
3. Suggest suitable embankment foundation treatment technique
4. Analyze stability of embankment for different considerations
5. Design an earthfill rock dam

GE15C ENVIRONMENTAL GEOTECHNOLOGY

L / week	**: 3Hrs**	**Sessional Marks**	**: 40**
University Exam	**: 3 Hrs**	**End Exam Marks**	**: 60**

UNIT I

SOIL AS A MULTIPHASE SYSTEM: Soil-environment interaction; Properties of water in relation to the porous media; Water cycle with special reference to soil medium.

UNIT II

SOIL MINERALOGY: significance of mineralogy in determining soil behavior; Mineralogical characterization.

UNIT III

MECHANISMS OF SOIL-WATER INTERACTION: Diffuse double layer models; Force of attraction and repulsion; Soil-water-contaminant interaction; Theories of ion exchange; Influence of organic and inorganic chemical interaction.

UNIT IV

CONCEPTS OF WASTE CONTAINMENT: Sources, production and classification of wastes, Environmental laws and regulations, physico-chemical properties of soil, ground water flow and contaminant transport, desirable properties of soil; contaminant transport and retention; contaminated site remediation.

UNIT V

SOIL CHARACTERIZATION TECHNIQUES: volumetric water content; gas permeation in soil; electrical and thermal properties; pore-size distribution; contaminant analysis. contaminated site characterization, estimation of landfill quantities, landfill site location, design of various landfill components such as liners, covers, leachate collection and removal, gas generation and management, ground water monitoring, end uses of landfill sites,

References

1. Mitchell, J.K and Soga, K., Fundamentals of Soil Behavior, John Wiley and Sons Inc., 2005.
2. Fang, H-Y., Introduction to Environmental Geotechnology, CRC Press,1997.
3. Daniel, D.E, Geotechnical Practice for Waste Disposal, Chapman and Hall, 1993.
4. Rowe, R.K., Quigley, R.M. and Booker, J.R., Clay Barrier Systems for Waste Disposal Facilities, E & FN Spon, 1995.
5. Rowe, R.K, Geotechnical and Geoenvironmental Engineering Handbook, Kluwer
6. Academic Publishers, 2001.
7. Reddi, L.N. and Inyang, H.F, Geoenvironmental Engineering - Principles and Applications, Marcel Dekker Inc, 2000.
8. Sharma, H.D. and Lewis, S.P, Waste Containment Systems, Waste Stabilization and Landfills: Design and Evaluation, John Wiley & Sons Inc., 1994.

Course Outcomes

The students will be able to

1. Understand Soil-environment interaction, Soil mineralogy and
2. Understand Mechanisms of soil-water interaction
3. Can assess ground water flow and predict contaminant transport phenomenon.
4. Can apply remediation techniques for contaminated site.

GE15C CRITICAL STATE SOIL MECHANICS

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks: 60**

UNIT I

SOIL BEHAVIOUR: State of stress and strain in soils, Stress and strain paths and invariants, behavior of soils under different laboratory experiments.

UNIT II

THE CRITICAL STATE LINE AND THE ROSCOE SURFACE: Families of undrained tests, Families of drained tests, the critical state line, drained and undrained surfaces, The Roscoe surface.

UNIT III

BEHAVIOUR OF OVER CONSOLIDATED SAMPLES: The Hvorslev surface: Behavior of Over consolidated samples, drained and undrained tests, The Hvorslev surface, complete State Boundary Surface, Volume changes and pore water pressure changes.

UNIT IV

BEHAVIOUR OF SANDS: The critical state line for sands, Normalized plots, the effect of dilation, Consequences of Taylor's model.

UNIT V

BEHAVIOUR OF SOILS BEFORE FAILURE: Elastic and plastic deformations, Plasticity theory, Development of elastic-plastic model based on critical state soil mechanics, The Cam-clay model, The modified Cam-clay model.

References:

1. J. H. Atkinson and P. L. Bransby, “The mechanics of soils: An introduction to
2. critical state soil mechanics”, McGraw Hill, 1978.
3. D. M. Wood, “Soil behaviour and critical state soil mechanics”, Cambridge University Press, 1990
4. B. M. Das, “Fundamental of geotechnical engineering”, Cengage Learning, 2013

Course Outcomes

The students will be able to:

1. Acquire fundamentals concept of Stresses and Strains and their states in soils.
2. Comprehend the critical state line and the Roscoe surface.
3. Gain knowledge on Cam-Clay model for analyzing the plastic behaviour of soils before failure.
4. Familiarize with the Development of constitutive laws for geotechnical materials including linear or nonlinear elastic (hyperbolic), linear elastic perfectly plastic, and non-linear elastic-plastic models based on the Critical State Soil Mechanics theory.

GE15C DEEP FOUNDATIONS

L + T / week : 3 Hrs | Sessional Marks : 40

University Exam: 3 Hrs | End Exam Marks : 60

UNIT - I

INTRODUCTION

Pile foundation – Necessity – Classification of piles – Methods of installation – Axially Loaded Piles - Single pile in cohesive and cohesionless soils – Piles in layered soils – Compressive and uplift loads – Negative skin friction – Settlement analysis.

UNIT – II

Laterally Loaded Piles : The occurence of lateral loading - Rigid and flexible piles - Ultimate lateral resistance and deflection of vertical piles carrying lateral loads by I.S. Code method, Brom's method and Reese and Matlock method.

UNIT – III

PILE GROUPS: Necessity – Spacing – Group efficiency – Pile groups in cohesive and cohesionless soils – Individual pile failure – Block failure – Negative skin friction – Free standing pile groups and piled rafts – Settlement analysis.

UNIT - IV

Well Foundations: Types of wells - Depth of well foundation - Bearing capacity and stability considerations - Terzaghi's analysis - IRC method.

UNIT - V

Computer Aided Design

Pile Foundations – Axially Loaded Piles – Laterally Loaded Piles and Pile Groups.

Reference Books :

1. Bowles : Foundation Analysis and Design.
2. V.N.S.Murthy : Soil Mechanics & Foundation Engineering.
3. Bowles : Analytical and Computer Methods in Foundation Engineering.
4. Zeevaret : Foundations for difficult subsoil conditions.
5. Chellis : Pile foundations.
6. Tschebotarioff : Soil Mechanics, Foundations and earth structure.

7. C.Venkatramaiah (1995), Geotechnical Engineering, Wiley Eastern Ltd. (New Age International Ltd.), New Delhi.

8. AV Narasimha Rao and C.Venkatramaiah, (2000), Numerical Problems, Examples and Objective Questions in Geotechnical Engg., Universities Press (India) Ltd., Hyderabad.

9.M.J.Tomlinson, Pile Design and Construction Practice, A View Point Publication, London.

10. H.G. Poules, Pile Foundation Analysis and Design, Ed. Davis, John Wiley & Sons, New York.
11. IS 2911 Part 1-1979 - Code of Practice for design and construction of pile foundations.

Course Outcomes

The students will be able to:

1. Analyze the loads and suggest methods of installation of piles in different soils.
2. Use different methods for competing the lateral resistance and deflection in laterally loaded piles.
3. Evaluate the capacity of pile groups and their efficiency consisting different failure conditions.
4. Analyze and design well foundations.
5. Develop a program for estimating the capacity of axially loaded, laterally loaded and pile groups.

GE11L GEOTECHNICAL ENGINEERING LAB - 1

Practicals / week	**:**	**4Hrs**	**Sessional Marks : 40**
University Exam	**:**	**3 Hrs**	**End Exam Marks : 60**

LIST OF PRACTICAL'S:

1. Determination of Moisture Content and Specific gravity of soil

2. Grain Size Distribution Analysis and Hydrometer Analysis

3. Atterberg Limits (Liquid Limit, Plastic limit, Shrinkage limit)

4. Visual Classification Tests

5. Vibration test for relative density of sand inclusive of in-situ density test.

6. Standard and modified proctor compaction test

7. Falling head permeability test and Constant head permeability test

8. Consolidation test.

Course Outcomes (COs):

The students will be able to:

1. Determine all Index Properties for cohesive and cohesionless soils
2. Determine Density Index for cohesionless soils.
3. Determine Compaction Characteristics for cohesive soils
4. Determine Permeability of cohesive and cohesionless soils.
5. Determine Consolidation Characteristics for cohesive soils.

GE12L GEOTECHNICAL ENGINEERING LAB - 2

Practicals / week :	**4Hrs**	**Sessional Marks**	**: 40**
University Exam :	**3 Hrs**	**End Exam Marks**	**: 60**

LIST OF PRACTICALS

1. Unconfined compression test
2. Direct shear test
3. Tri-axial compression test – UU, CU, CD tests
4. Laboratory vane shear test
5. Swelling Characteristics (Swell Pressure, Swell Potential and swelling Index) by Free-Swell Oedo-Meter method.
6. Swelling Characteristics by Constant Volume Method.

Course Outcomes (COs):

The students will be able to:

1. Determine Unconfined Compressive Stress for cohesive soils.
2. Determine shear parameters for cohesive and cohesionless soils.
3. Determine Swelling Characteristics of cohesive soils by different methods.

GE21C DYNAMICS OF SOILS AND FOUNDATIONS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks: 60**

UNIT I

FUNDAMENTALS OF VIBRATIONS: Single, two and multiple degree of freedom systems, vibration absorbers, vibration measuring instruments.

UNIT II

WAVE PROPAGATION: Elastic continuum medium, semi-infinite elastic continuum medium, soil behavior under dynamic loading.

UNIT III

DYNAMIC ELASTIC CONSTANTS OF SOIL: Determination of dynamic elastic constants, various methods including block resonance tests, cyclic plate load tests, wave propagation tests, oscillatory shear box test.

UNIT IV

MACHINE FOUNDATIONS: Design criteria for machine foundations; Elastic homogeneous half space and lumped parameter solutions, analysis and design of foundations for reciprocating and impact type machines, turbines, effect of machine foundation on adjoining structures.

UNIT V

BEARING CAPACITY OF FOUNDATIONS: Introduction to bearing capacity of dynamically loaded foundations, such as those of water towers, chimneys and high rise buildings.

VIBRATION ISOLATION: Active and passive types of isolation – Screening of vibrations – Isolation in existing machine foundations.

References

1. Das, B.M., “Fundamentals of Soil Dynamics”, Elsevier,1983.
2. Steven Kramer, “Geotechnical Earthquake Engineering”, Pearson,2008.
3. Prakash, S., Soil Dynamics, McGraw Hill, 1981.
4. Kameswara Rao, N.S.V., Vibration analysis and foundation dynamics, Wheeler Publication Ltd., 1998.
5. Richart, F.E. Hall J.R and Woods R.D., Vibrations of Soils and Foundations, Prentice Hall Inc., 1970.
6. Prakash, S. and Puri, V.K., Foundation for machines: Analysis and Design, John Wiley & Sons, 1998.

Course Outcomes

The students will be able to:

1. Students understands theory of vibration and resonance phenomenon, dynamic amplification
2. Students understand propagation of body waves and surface waves through soil.
3. Students get exposed to different methods for estimation of dynamic soil properties required for design purpose.
4. Students can apply theory of vibrations to design machine foundation based on dynamic soil properties and bearing capacity.
5. Students can predict dynamic bearing capacity and methods of vibration isolation.

GE22C SUBSURFACE INVESTIGATION AND INSTRUMENTATION

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT - I GENERAL

Purpose of soil exploration – Planning a sub-surface exploration – Stages in sub-surface exploration – Depth of exploration – Lateral extent of exploration.

UNIT - II OPEN EXCAVATION AND BORINGS OF EXPLORATION

Pits and Trenches – Drifts and shafts – Auger Borings – Wash borings – Rotary drilling – Percussion drilling – Core drilling.

UNIT - III SOIL SAMPLES AND SAMPLERS

Types of soil samples – Disturbed samples – Undisturbed samples – Design features affecting the Sample Disturbance – Split Spoon Samplers – Scraper Bucket Samplers – Shellby Tubes and Thin walled Samplers – Piston Samlers – Denison Samplers – Hand-curved Samplers.

UNIT – IV IN-SITU TESTING

Standard Penetration Tests – Cone Penetration Tests – In-situ Vane Shear Test – Plate Load Test – Field Permeability Tests – In-situ Tests Using Pressure meter – Observation of Ground Water Table.

UNIT – V GEOPHYSICAL METHODS

Seismic Methods – Electrical Resistivity Methods – Electrical Profiling Method – Electrical Sounding Method – Common Soil Tests – Sub-soil Investigation Report.

References

1. Subsurface exploration and sampling of soils for Civil Engineering purposes by Hvorslev, M.J., Waterways Experiment Station, Vicksburg, Mississipi, 1949.
2. Foundation Engineering by S.P.Brahma Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 1985.
3. Analysis and Design of Foundations and Retaining Structures by Shamsher Prakash, Gopal Ranjan and Swami Saran, Sarita Prakasham, Meerut, 1979.
4. Soil Mechanics & Foundation Engineering, Vol.2 by V.N.S. Murthy, Sai Kripa Technical Consultants, Bangalore.
5. Geotechnical Engineering by C.Venkatramaiah, Wiley Eastern Ltd., New Delhi. Relevant I.S. Codes.

Course Outcomes

The students will be able to:

1. Plan subsurface investigations based on the requirement of civil engineering project and site condition and finalize depth and number of boreholes required.
2. Select methods of exploration.
3. Suggest types of samples to be collected and samplers.
4. Execute different insitu tests for arriving properties of soil and Ground Water Table.
5. Suggest indirect methods for soil exploration and can propose a soil investigation report.

GE23C MARINE GEOTECHNIQUES

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

MARINE SOIL DEPOSITS: Offshore environment, Offshore structures and foundations, Specific problems related to marine soil deposits, Physical and engineering properties of marine soils

UNIT II

BEHAVIOUR OF SOILS SUBJECTED TO REPEATED LOADING: Effect of wave loading on offshore foundations, Behavior of sands and clays under cyclic loading, Laboratory experiments including repeated loading, Cyclic behavior of soils based on fundamental theory of mechanics, Approximate engineering methods which can be used for practical cases

UNIT III

SITE INVESTIGATION IN THE CASE OF MARINE SOIL DEPOSITS: Challenges of site investigation in marine environment, Different site investigation techniques, sampling techniques, Geophysical methods, Recent advancements in site investigation and sampling used for marine soil deposits

UNIT IV

FOUNDATIONS IN MARINE SOIL DEPOSITS: Different offshore and near shore foundations, Gravity platforms, Jack-up rigs.

UNIT V

DEEP FOUNDATIONS AND ANCHORS: Pile foundation – Axial capacity – Lateral capacity – Deflections – Construction – Anchored foundations.

References

1. H. G. Poulos. “Marine Geotechnics”, Unwin Hyman Ltd, London, UK, 1988
2. D. V. Reddy and M. Arockiasamy, “Offshore Structures”, *Volume: 1*, R.E. Kreiger Pub and Co., 1991
3. D. Thomson and D. J. Beasley, “Handbook of Marine Geotechnical Engineering”, US Navy, 2012

Course Outcomes

The students will be able to:

1. Understand the Physical and Engineering properties of marine soils and problems specific to marine soil deposits.
2. Gain knowledge on Behaviour of sands and clays under cyclic loading
3. Can plan Site investigation in marine environment including Geophysical methods.
4. Can assess the factors governing the choice of the most suitable type of foundation for a given marine Structure.
5. Can Select Suitable type of foundation for a given marine structure.

GE23C COMPUTATIONAL GEOMECHANICS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

SOLUTION OF LINEAR EQUATIONS Jacobi's method, Gauss Seidal method, Successive over relaxation method.

UNIT II

FINITE DIFFERENCE METHOD Two point Boundary value problems – Disichlet conditions, Neumann conditions; ordinary and partial differential equations.

UNIT III

CORRELATION AND REGRESSION ANALYSIS Correlation - Scatter diagram, Karl Pearson coefficient of correlation, Limits of correlation coefficient; Regression –Lines of regression, Regression curves, Regression coefficient, Differences between correlation and regression analysis.

UNIT IV

ONE-DIMENSIONAL CONSOLIDATION - Theory of consolidation, Analytical procedures, Finite difference solution procedure for multilayered systems.

UNIT V

FLOW THROUGH POROUS MEDIA - Geotechnical aspects, Numerical methods, Applications and Design analysis.

References

1. S. Chandrakant., Desai and John T. Christian, "Numerical Methods in Geotechnical Engineering", Mc. Graw Hill Book Company, 1977.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, "Numerical Methods for Scientific and Engineering computations", Third edition, New Age International (P) Ltd. Publishers, New Delhi.
3. D.J. Naylor and G.N. Pande, "Finite Elements in Geotechnical Engineering", Pineridge.

Course Outcomes

The students will be able to:

1. Solve linear equations
2. Apply Finite difference form of ordinary and partial differential equations
3. Understand Difference between correlation and regression analysis.
4. Apply finite difference technique to solve complex consolidation and seepage problems in Geotechnical Engineering.

GE23C ENGINEERING ROCK MECHANICS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

ROCK Formation of rocks, Physical properties, Classification of rocks and rock masses, Elastic constants of rock; Insitu stresses in rock. Application of Rock mechanics in Civil Engineering

UNIT II

ROCK TESTING: Laboratory and Field tests including field sampling

UNIT III

DISCONTINUITIES IN ROCK MASSES: Discontinuity orientation, Effect of discontinuities on strength of rock

UNIT IV

STRENGTH BEHAVIOUR: Compression, Tension and Shear, Stress-Strain relationships, Rheological behaviour

UNIT V

STRENGTH/ FAILURE CRITERION: Mohr-Coulomb, Griffith theory, Hoek and Brown, strength and other strength criteria. Stresses in rock near underground openings;

References

1. Hudson J.A. and J.P. Harrison. Engineering Rock Mechanics: an Introduction to the Principles, 1997. Elsevier, Oxford
2. Goodman, R.E. Introduction to Rock Mechanics, John Wiley & Sons.
3. Ramamurthy, T., “Engineering in Rocks”, PHI Learning Pvt. Ltd.
4. Jaeger, J.C. and Cook, N.G.W, Fundamentals of Rock Mechanics, Chapman and Hall, 1976.
5. Wyllie, D.C., Foundations on Rock, E & FN Spon. 2nd Edition, 1992.

Course Outcomes

The students will be able to:

1. Assess the Physical and Mechanical properties of rocks.
2. Adopt direct & indirect methods of rock exploration.
3. Conduct different laboratory tests on rocks and analyse the results for rock properties
4. Asses Stress Strain behavior under Compressive, tension and Shear
5. Apply Strength criteria functions to analyze stresses in rocks.

GE23C GEOTECHNICAL EARTHQUAKE ENGINEERING

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

EARTHQUAKE SEISMOLOGY: Causes of earthquake, Plate tectonics, Earthquake fault sources, Seismic waves, Elastic rebound theory, Quantification of earthquake, Intensity and magnitudes, Earthquake source models.

UNIT II

EARTHQUAKE GROUND MOTION: Seismograph, Characteristics of ground motion, Effect of local site conditions on ground motions, Design earthquake, Design spectra, Development of site specification and code-based design.

UNIT III

GROUND RESPONSE ANALYSIS: One-dimensional ground response analysis: Linear approaches, Equivalent linear approximation of non-linear approaches.

UNIT IV

LIQUEFACTION AND LATERAL SPREADING: Liquefaction related phenomena, Liquefaction susceptibility: Historical, Geological, Compositional and State criteria. Evaluation of liquefaction by cyclic stress and cyclic strain approaches, Lateral deformation and spreading, Criteria for mapping liquefaction hazard zones.

UNIT V

Seismic design of foundations, Seismic slope stability analysis: Internal stability and weakening instability and Seismic design of retaining walls.

References

1. Steven Kramer, “Geotechnical Earthquake Engineering”, Pearson,2008.

2. Seco e Pinto, P., Seismic behaviour of ground and Geotechnical structure, A. A.
3. Naeim, F., The Seismic Design Handbook, Kluwer Academic Publication, 2ndEdition, 2001.
4. Ferrito, J.M, Seismic design criteria for soil liquefaction, Tech. Report of Naval Facilities service centre, Port Hueneme, 1997.

Course Outcomes

The students will be able to:

1. Know the causes and quantification of earthquake.
2. Get exposed to the effect of earthquake and ground motion.
3. Understand Ground response Analysis and Liquefaction effects.
4. Understand the seismic design of foundation

GE24C DESIGN OF UNDERGROUND EXCAVATIONS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Introduction, planning of and exploration for various underground construction projects, stereographic projection method, principle and its application in underground excavation design.

UNIT II

Elastic stress distribution around tunnels, stress distribution for different shapes and under different in-situ stress conditions, Greenspan method, design principles, multiple openings, openings in laminated rocks, elasto-plastic analysis of tunnels, Daemen's theory

UNIT III

Application of rock mass classification systems, ground conditions in tunneling, analysis of underground openings in squeezing and swelling ground, empirical methods, estimation of elastic modulus and modulus of deformation of rocks; uniaxial jacking / plate jacking tests, radial jacking and Goodman jacking tests, long term behavior of tunnels and caverns, New Austrian Tunneling Method (NATM), Norwegian Tunneling Method (NTM), construction dewatering.

UNIT IV

Rock mass-tunnel support interaction analysis, ground response and support reaction curves, Ladanyi'selasto-plastic analysis of tunnels, design of various support systems including concrete and shotcrete linings, steel sets, rock bolting and rock anchoring, combined support systems, estimation of load carrying capacity of rock bolts

UNIT V

In-situ stress, flat jack, hydraulic fracturing and over coring techniques and USBM type drill hole deformation gauge, single and multi-point bore hole extensometers, load cells, pressure cells, etc.

Instrumentation and monitoring of underground excavations, during and after construction, various case studies.

References

1. Hoek, E and and Brown, E. T.," Underground Excavations in Rocks", Institute of Mining Engineering.
2. Obert, L. and Duvall, W.I., "Rock Mechanics and Design of Structures in Rocks", John Wiley.
3. Singh, B. and Goel, R.K.,"Rock Mass Classification- A Practical Engineering Approach", Elsevier.
4. Singh, B. and Goel, R.K., "Tunnelling in Weak Rocks", Elsevier

Course Outcomes

The students will be able to:

1. Plan exploration for various underground projects.
2. Understand the use of elastic and plastic analysis in the design of underground support system.
3. Classify rock masses and select suitable method for advising tunnels.
4. Design various tunnel support system.
5. Gain awareness on the field tests generally conducted during and after construction of under structures.

GE24C FOUNDATION ON EXPANSIVE SOILS

L + T / week : 3Hrs Sessional Marks : 40

University Exam: 3 Hrs End Exam Marks : 60

UNIT – I
GENERAL PRINCIPLES:

Origin of expansive soils - Physical properties of expansive soils – Mineralogical composition - Identification of expansive soils - Field conditions that favour swelling - Consequences of swelling.

UNIT – II
SWELLING CHARACTERISTICS:
Swelling characteristics – Laboratory tests – Prediction of swelling characteristics – Evaluation of heave.

UNIT – III
TECHNIQUES FOR CONTROLLING SWELLING
Horizontal moisture barriers – Vertical moisture barriers – Surface and subsurface drainage – Prewetting – Soil replacement – Sand cushion techniques – CNS layer technique.

UNIT – IV
FOUNDATIONS ON EXPANSIVE SOILS :

Belled piers - Bearing capacity and skin friction - Advantages and disadvantages - Design of belled piers - Underreamed piles - Design and construction.

UNIT – V
MODIFICATION OF SWELLING CHARACTERISTICS

Lime stabilization – Mechanisms – Limitations – Lime injection – Lime columns – Mixing – Chemical stabilization – Construction.

Reference Books:

1. FU HUA CHEN, Foundations on Expansive Soils, Elsevier Scientific Publishing Company, New York.

2. Gopal Ranjan & A.S.R.Rao, Basic and Applied Soil Mechanics, New Age International Publishers - New Delhi.

3. Hand Book on Underreamed and Bored Compaction Pile Foundation, CBRI, Roorkee.

4. IS : 2720 (Part XLI) - 1977 - Measurement of Swelling Pressure of Soils.

5. R.K.Katti, Search for Solutions in Expansive Soils.

6. Alam Singh, Modern Geotechnical Engineering, Geo-Environ Academia, Jodhapur.

7. Swami Saran, Analysis and Design of Substructures, Oxford & IBH, New Delhi.

Course Outcomes

The students will be able to:

1. Identify expansive soil and the factors forming swelling with their consequences.
2. Evaluate the swelling characteristics from laboratory test results
3. Suggest appropriate technique for controlling swelling in expansive soil
4. Design appropriate foundation on expansive soils.
5. Infer the methods for modification of swelling characteristics

GE24C STABILITY ANALYSIS OF SLOPES

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

SLOPES: Types and causes of slope failures, mechanics of slope failure, failure modes.

UNIT II

STABILITY ANALYSIS: Infinite and finite slopes with or without water pressures; concept of factor of safety, pore pressure coefficients, Mass analysis, Wedge methods, friction circle method ; Method of slices, Bishop's method, Janbu's method, Morgenstern and Price, Spencer's method.

UNIT III

STABILITY ANALYSIS IN THE PRESENCE OF SEEPAGE: Two dimensional flow – Laplace equation and it's solution, graphical method, determination of phreatic line, flow nets in homogeneous and zoned earth dams under steady seepage and draw-down conditions, seepage control in earth dams, influence of seepage on slope stability stability analysis of dam body during steady seepage.

UNIT IV

STRENGTHENING MEASURES: stabilization of slopes by drainage methods, surface and subsurface drainage, use of synthetic filters, retaining walls, stabilization and strengthening of slopes, shotcreting, rock bolting and rock anchoring.

UNIT V

Instrumentation and monitoring of slopes, slope movements, warning devices, maintenance of slopes

References:

1. Chowdhary R and Chowdhary I , "Geotechnical Slope Analysis", CRC Press.
2. Harr M.E.," Ground Water and Seepage", McGraw Hill. 1962

Course Outcomes

The students will be able to:

1. Identify types and causes of slope failures.
2. Check the stability of earthen dams
3. Analyze stability of slopes in pressure of seepage
4. Suggest safety measures to be undertaken to prevent the instability of slopes, earthen dams and embankments.
5. Understand the aspects of maintenance and monitoring of slopes.

GE24C FOUNDATIONS ON WEAK ROCKS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Engineering properties of weak rocks, different rock mass classification systems, relative merits and demerits. Failure criteria for weak rocks, bi-linear Mohr-Coulomb failure criterion, Hoek and Brown criterion and modified Hoek and Brown failure criterion etc.

UNIT II

Effect of structural planes on rock foundations, possible modes of failure of foundations on rocks/ rock masses, determination of in-situ shear strength of rocks and rock masses

UNIT III

Requirements for satisfactory performance of foundations, bearing capacity of foundations on rocks and rock masses, allowable bearing pressure of rock foundations using a nonlinear failure criterion, monotonic and cyclic plate load tests. Pressure-settlement characteristics, effect of layering, anisotropy, heterogeneity andinelasticity

UNIT IV

Shallow foundations, shallow foundations on sloping ground, raft foundations, stilt foundations, foundations for suspension bridges, transmission line towers, framed buildings etc, treatment of foundations - open joints, solution cavities, weak seams

UNIT V

Piles in weak rocks, bearing capacity and settlement of piles, piles in stratified rock masses, field load tests on piles in weak rocks, behaviour of bored / driven piles in soft / weathered rocks.

References

1. Wyllie Duncan C.," Foundations on Rock: Engineering Practice", E&FN Spon, Taylor and Francis.
2. Hudson J.A. and J.P. Harrison. Engineering Rock Mechanics: an Introduction to the Principles, 1997. Elsevier, Oxford
3. Singh, B. and Goel, R.K.,"Rock Mass Classification- A Practical Engineering Approach", Elsevier.
4. Ramamurthy, T., "Engineering in Rocks", PHI Learning Pvt. Ltd.
5. Hoek, E., "Practical Rock Engineering", Rock science.

Course Outcome

The students will be able to:

1. Understand Rock mass classification and its Engineering properties.
2. Determine engineering properties of in-situ rocks and modes of failure associated.
3. Assess allowable Bearing pressure.
4. Design different types of foundations planned over rock mass.

GE21L SUB SOIL EXPLORATION LAB

L / week	**: 4Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

LIST OF PRACTICALS

1. Field vist
2. Field sampling and transports
3. Determination of Identification tests.
4. Determination of Engineering properties
5. Assessment of Allowable Bearing Pressure of foundations.

Course Outcomes (COs)

The students will be able to:

1. Evaluate vertical and lateral extent of exploration; identify, select, and plan different stages of subsurface exploration for various civil engineering projects.
2. Discriminate, Classify and analyse different techniques of exploration to be adopted in rocks and soils.
3. Discriminate different types of soil samples, samplers and judge the appropriateness of a sample or sampler for practical cases accounting for the safety and economy.
4. Evaluate different in-situ methods of tests to determine engineering properties of soils and locate Ground water table required for safe and economic design of foundations.
5. Asses the safe bearing capacity/Allowable Bearing Pressure of soils.

GE22L NUMERICAL ANALYSIS LAB

P/ week	**: 4Hrs**	**Sessional Marks :40**
University Exam	**: 3 Hrs**	**End Exam Marks: 60**

SYLLABUS CONTENTS

1. Development of spread sheets for Analysis of laboratory tests results.
2. Development of Spread sheets for stress distribution, Bearing Capacity and settlements
3. Curve fitting

Course Outcomes (COs)

The students will be able to:

1. Develop and Analyze laboratory tests results using Spread sheets
2. Develop and analyze Spread sheets for stress distribution for different loading conditions.
3. Determine Bearing Capacity of given soil sample.
4. Determine settlements of foundation in soils.

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Curriculum & Syllabi for Hydraulics & Water Resource Engineering

(w.e.f 2023-24)

MAY, 2023

PROGRAM OBJECTIVES

1. To learn the principles, processes and design of pressurized and free surface system.

2. To achieve competency in the pipe network design, analysis of channel networks, pressure rise in pipes due to sudden closure of valves, etc.

3. To assess the impact of climate change detection, Land use/Land cover changes on water availability

4. Efficient use of water in irrigation under varying climate change.

5. Impact of climate change on glaciers, consumptive use of surface and ground water, and optimum allocation of water.

6. Evaluation of various hydrologic processes including flow forecasting and the related practical applications.

WE11C ADVANCED FLUID MECHANICS

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks: 60**

UNIT I: Kinematics of Flow: Equation of continuity in cartesian, polar and cylindrical coordinates, Standard 2D Flow Patterns: Source, sink, doublet and their combinations, construction of flows by superposition, D'Alembert's paradox

UNIT II: Ideal fluid flow

Simple patterns of 2-dimensional flow - Uniform flow, Source, sink, vortex flow, Superposition of elementary flows – Doublet – Rankine-half body - Rankine oval, flow about a circular cylinder and flow about a rotating cylinder.

UNIT III:. Laminar Flow: Derivation of Navier-Stokes equations – exact solutions for flow between parallel plates, Couette flow, flow near a suddenly accelerated plate and an oscillating plate.

UNIT IV: Boundary Layers: Similarity solutions of boundary layer equations, Falkner-Skan Wedge flows, Karman's momentum integral equations, Karman-Puhlhausen approximate solution, separation in boundary layer under adverse pressure gradient, turbulent boundary layer.

UNIT V: Turbulent Flows: Reynolds equations of motion, semi-empirical theories of turbulence, velocity profiles for inner, outer and overlap layers, equilibrium boundary layers.

References:

1. White, F.M., "Fluid Mechanics", McGraw-Hill. 1979
2. Schlichting, H., "Boundary Layer Theory", McGraw-Hill. 1979 Garde, R.J., "Turbulent Flow", Wiley Eastern Limited. 1994
3. Pope, S. B., "Turbulent Flows", Cambridge University Press. 2000
4. Rouse, H., "Advanced Mechanics of Fluids", John Wiley and Sons. 1959
5. Ojha, C.S.P., Berndtsson, R. and Chandaramouli, P.N., "Fluid Mechanics", Oxford University Press. 2010

Course Outcomes (CO's)

After completion of the course the student will have:

1. Able to analyze the fluids in motion condition
2. Able to apply the principles of ideal fluid flow and real fluid flow
3. Able to apply the principles of viscous flow of fluids
4. Able to find out different layer of boundary layer and identifying the separation and control
5. Able to analyze the fluids in turbulent flow conditions.

WE12C FREE SURFACE FLOWS

L / week : 3Hrs **Sessional Marks : 40**
University Exam : 3 Hrs **End Exam Marks : 60**

UNIT I

INTRODUCTION: Free surface flows, velocity distribution, resistance relationships, specific energy and specific force, normal and critical depths computations, governing equation and computation of gradually varied flows.

UNIT II

HYDRAULIC JUMP: Elements of hydraulic jump, hydraulic jump in variety of situations including contracting and expanding geometries and rise in floor levels, control of hydraulic jump using baffle walls and cross jets.

UNIT III

SUPERCRITICAL FLOWS: Flow past deflecting boundaries, oblique shock waves.

Spatially Varied Flows: Flows past side weirs, De Marchi equations, design of side weirs, flow past bottom racks, trench weirs and waste water gutters.

UNIT IV

AERATED FLOWS: Bulking of flow, mechanism of air entrainments, modelling of aerated flows, development of self-aerated flows, uniform aerated region, aeration over spillway.
Stratified Flows: Thermal stratification in water bodies including reservoirs, modelling of stratified flows.

UNIT V

UNSTEADY FLOWS: St. Venant's equations and their solution using method of characteristics and finite difference schemes; dam break problem, hydraulic flood routing. Channel Transitions: Sub-critical and supercritical.

References:

1. Chow, V.T., "Open Channel Hydraulics", McGraw Hill. 1959

2. Choudhary, M.H., "Open-Channel Flows", Prentice-Hall.
1994
3. Ranga Raju, K.G., “Flow Through Open Channels, Tata McGraw Hill. 2003
4. Chanson, H., “The Hydraulics of Open Channel Flow: An Introduction”, Elsevier.
2004 French, R.H., "Open-Channel Hydraulics", McGraw-Hill. 1994
5. Wood, I.R., “Air entrainment in free-surface flows”, A.A. balkema. 1991

Course Outcomes

1. Able to compute flow profile in channel transition

2. Able to apply various principles in unsteady flow conditions

3. Able to formulate and solve the hydraulic flood routing

4. able to apply concepts on aerated flows.

WE13C WATERSHED MANAGEMENT AND MODELLING

L / week : 3Hrs **Sessional Marks : 40**
University Exam : 3 Hrs **End Exam Marks : 60**

UNIT -I

WATERSHEDMANAGEMENT-I:

Basin characteristics - Classification of effective watershed management methods - Factors affecting integrated watershed management - Watershed inventory.

UNIT -II

WATERSHED MANAGEMENT II :

Problem definition and scope - Consultation process - Developing workable management options - Evaluation of constraints and criteria - Simple assessment methods.

WATERSHED MODELLING I :

Runoff components- correlation coefficient, linear regression- least square's method, coefficient of determination, t-and F-test; Types of model- black box, parametric and physically based;cuvillinear relations, multi-linear regression model.

UNIT -III

WATERSHED MODELLING II :API & wetness performance, calibration, validation, errors, coefficient of efficiency and other tests, graphical methods. Simple parametric models- Curve Number Method, its modification, variable source area models; quasi- physically based models; a simple physically based model.

UNIT -1V

SOIL CONSERVATION:

Soil loss estimation - Universal soil loss equation; soil erosion principles - Gulley erosion - Design of permanent gully control structures - Stream bank erosion - Erosivity and erodability, Engineering measures to control erosion - Terracing, bunding, vegitated waterways. Wind erosion and control practices.

UNIT –V

ARTIFICIAL GROUNDWATER RECHARGE TECHNIQUES AND WATER HARVESTING TECHNIQUES:

Artificial recharge - Considerations - Methods - Induced Infiltration - Water Spreading - Flooding - Artificial recharge basins and distches - Natural channel modifications - Recharge pits and shafts - Recharge wells. Farm ponds- Percolation tanks.

Reference Books :

1. Prof. R.Suresh, "Watershed Hydrology" Standard Publishers.
2. Isobel W. Heathiote."Integrated Watershed Management - Principles & Practices".
3. Schwab, G.O. & Others, "Soil and Water Conservation Engg."
4. Prof.R.Suresh, "Soil and Water Conservation Engg.",

   (Standard Publishers).
5. Wayne A. Pettyjohu, "Introduction to Artificial Ground Water Recahrge" Scientific

   Publishers, Jodhpur.
6. Murthy J.V.S., "Wastershed Management".

Course outcomes:

1. Able to use watershed management methods and optimization techniques

3. Able to apply soil conservation equation and principles

4. Able to use water harvesting techniques and artificial recharge techniques

WE14C FLUVIAL HYDRAULICS

L / week : 3Hrs **Sessional Marks : 40**
University Exam : 3 Hrs **End Exam Marks : 60**

UNIT I

The sediment problems, properties of sediments, incipient motion of uniform and non-uniform sediments. Bed forms- mechanics of bed forms, classifications and channel resistance.

UNIT II

Bed load equation, Bed layer characteristics, sediment sampling, measurement and suspended load – sediment concentration, Advection-diffusion equation, suspended sediment concentration profile, Hyper concentration, Field measurements of suspended sediments.

UNIT III

Stable channel design and sediment control – Introduction- variable in channel design and conditions – secondary factors influencing stable channel design- stable channel carrying clear water- Non cohesive material-stable channel carrying sediments-sediment control .

UNIT IV

Bed level variations- continuity equation for sediment – equilibrium depth of scour in long channel contractions- stream bed changes during floods- degradation – aggradations

UNIT V

General mathematical models –silting of reservoirs –local scour- Design of guide bunds and other river training banks.

References:

1. Garde, R.J., "River Morphology", New International Publishers. 2006

2. Julien, P.Y., "Erosion and Sedimentation", Cambridge University Press. 1998 3. Jansen, P.P.H., "Principals of River Engineering", VSSD Publications. 1994

4. Garde, R.J. and Ranga Raju, K.G., "Mechanics of Sediment Transportation and Alluvial Stream Problems", Wiley Eastern Limited. 2006

Course Outcomes

After completion of the course the student will able to

1. Exposure to resistance laws in mobile bed channels/rivers. Scour around bridge piers
2. Design of river protection works

WE14C HYDRAULIC STRUCTURES

L / week : 3Hrs **Sessional Marks : 40**
University Exam : 3 Hrs **End Exam Marks : 60**

UNIT I

HYDRAULIC STRUCTURES – INTRODUCTION- Types of Hydraulic structures – water retaining structures – water conveying structures. Embankment Dams: Types, design considerations, seepage analysis and control, stability analysis, construction techniques.

UNIT II

GRAVITY DAMS: Forces acting on failure of a gravity dam, stress analysis, elementary profile, design of gravity dam, other functional features of a gravity dam.

UNIT III

DAM OUTLET WORKS: Types of outlet structures, ogee spillway, chute spillway, siphon spillway, side channel spillway,.

UNIT IV

TERMINAL STRUCTURES: Hydraulic jump types, stilling basin, roller bucket, ski jump b**asi**n, baffled spillway, drop structure

UNIT V

HYDRAULIC MODELING: Basic principles, dimensional analysis, design of physical models of hydraulic structures.

References:

1. Peterka, A.J, “Hydraulic Design of Stilling Basins and Energy Dissipators”, USBR Engineering Monographs No. 25”. 1984
2. Design of Small Dams", Third Edition, Water Resources Technical Publication – US Bureau of Reclamation. 1987
3. Singh, B., and Varshney, R.S., "Embankment Dam and Engineering", Nem Chand and Brothers. 2004
4. Novak, P. and Nalluri, C., “Hydraulic Structures”, Edition 4, Taylor & Francis. 2007 Creager, Justin and Hinds, “Engineering for Dams”, Vol. I and II, John Wiley.

Course Outcome

1. After completion of the course the student will have the ability toAnalysis and design of various types of hydraulic structures

WE14C SYSTEMS ENGINEERING

L / week : 3Hrs **Sessional Marks : 40**
University Exam : 3 Hrs **End Exam Marks : 60**

UNIT I

Definitions and components of a system, system control, systems modelling and model development. System synthesis. Economic analysis, conflicts and role of optimization in their resolution.

UNIT II:

Unconstrained optimization – classification – univariate method – Hook-Jeeves pattern search method –powell's search method – Indirect search method – Cauchy's steepest descent method – newton' method.Constrained optimization – elimination method, penality and barrier function method, sequential quadratic programming, mixed integer programming.

UNIT III

Integer programming: Introduction – Integer Linear programming – Graphical Representation – Gomory's cutting plane method (mixed integer programming- sequential discreat programming. Geometric programming: unconstraind geometric programming using differential calculus-arithmetic-geometric inequality

UNIT IV

Linear programming: Geometry of linear programming- Linear simultaneous equation – simplex method- revised simplex method- Duality in linear programming. Dynamic programming-Multistage decision process- concept of sub-optimization and principle and optimality-computational procedure in dynamic programming.

UNIT V

Stochastic programming- Introduction – concept or probability theory – stochastic non-linear programming- geometric programming.

References:

1. Aguilera, R.J., "Systems Analysis and Design", Prentice Hall. 1973
2. Ossenbruggen, P. J., "Systems Analysis for Civil Engineering", John Wiley. 1984
3. Neufrille, R., "Systems Analysis for Engineer" , McGraw Hill. 1971

4. Rao, S.S., "Engineering Optimization – Theory and Practice", New Age International (P) Ltd. 1999
5. Hamdy, A.T., "Operations Research – An Introduction", Prentice Hall. 1997

Course Outcome

1. At the completion of the course the students will be able to understand the system behaviors and know how to apply the various simulation and optimization techniques to achieve optimum utilisation of water resources

WE14C HYDRAULIC MODELLING AND EXPERIMENTAL TECHNIQUES

L / week : 3Hrs **Sessional Marks : 40**
University Exam : 3 Hrs **End Exam Marks : 60**

UNIT – I

HYDRAULIC MODELLING

Hydraulic models - Scale effects - Distorted models - movable bed models - Analogy methods - Design and analysis of experiments - errors in experiments.

UNIT - II

EXPERIMENTAL TECHNIQUES AND MEASUREMENTS

Velocity and pressure measuring Instruments - Pitot cylinder, Pitot sphere, - Anaemometers- Pressure transducers.

UNIT - III

Discharge measuring techniques - Classification of methods - Constriction methods, rotometer - Area-velocity method - Dilution methods and techniques - Special techniques and measuring structures.

UNIT - IV

Measurement of two phase flows - measurement of sediment content in water flows - air-water mixture. Test rigs - Wind and water tunnels - Drag balances.

UNIT - V

Flow visualization techniques- Smoke or dye- Line tracers – oil films – china clay – shadowgraph – direct-shadow method – schlieren method – Interferometer – Examples.

Reference Books :

1. Huntley, H.E. Dover (1967),"Dimensional Analysis"
2. B.B.Sharp (1982), "Hydraulic Modeling" Published by Butter Worths.
3. Troskolousky (1960), "Hydrometry" Pergamon Press, London.
4. Addison, H. Chapman and Hall (1940), "Hydraulic Measurements".
5. Bradshaw, P.(1964), "Experimental Fluid Mechanics", Pergamon Press,
6. Ed. Richard, J. Goldstein, "Fluid Mechanics Measurements" published by

   Hemisphere Publishing Corporation (Distributed by Springer-Verlag).

Course Outcomes (Cos)

Learners should be able to

1. Able to design the prototype by analyzing the models and applying latest techniques for good
   efficiency
2. Able to measure the flow in all channels by using latest measurement devices.
3. Able to measure the sediment transport rate in regime flows.

WE15C WATER RESOURCES SYSTEMS PLANNING

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

INTRODUCTION: Water resources planning process, multi-objective planning.Evaluation of Water Plans: Basic concepts of engineering economics, welfare economics, economic comparison of alternatives.

UNIT II

WATER PLAN OPTIMIZATION: Plan formulation, objective functions and constraint, analytical optimization, numerical optimization, linear programming, dynamic programming, simulation, planning under uncertainty.

UNIT III

DETERMINISTIC RIVER BASIN MODELING: Stream flow modeling, estimation of reservoir storage requirements – dead storage, active storage for water supply/ irrigation / power generation, flood storage, optimal allocation.

UNIT IV

CONJUNCTIVE USE/GROUNDWATER MANAGEMENT MODELS: LP based conjunctive use modeling, aquifer response models, link - simulation, embedded, matrix response based models, soft modeling.

UNIT V

WATER QUALITY MANAGEMENT MODELS: Basic water quality modeling, objectives of management, control alternatives, optimal plans.

References:

1. Hall, W.A. and Dracup, J.A., "Water Resources Systems Engineering", McGraw Hill Book Company. 1970

2. Loucks, D.P., "Water Resource Systems Planning and Analysis", Prentice Hall. 1981

3. Maass et al., "Design of Water-Resource Systems", Harvard University Press. 1962

4. Vedula S. and Mujumdar, P.P., "Water Resources Systems", Tata McGraw Hill. 2005

Course Outcome

1. Able to use optimum utilisation of surface and subsurface water
2. Able to Rational allocation of reservoir water
3. Able to Exposure to various algorithms to solve linear as well as non-linear problems.

WE15C IRRIGATION AND DRAINAGE

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Introduction, objectives of irrigation, type of irrigation and suitability; selection of irrigation method. Irrigation requirement, water balance, soil water relationships, water storage zone, infiltration.

Unit II

Flow of moisture through root zone, soil physical and chemical properties, crop evaporative and drainage requirements, irrigation efficiency and uniformity.

UNIT III

Surface irrigation systems, types of surface systems, basin irrigation, border irrigation, furrow irrigation, field measurement techniques, flow measurement, flumes, weirs, irrigation events, advance, wetting, depletion and recession phases.

UNIT IV

Infiltration, infiltrometer, ponding methods, soil water, tensiometers, neutron probe, time domain reflectometer, evapotranspiration, crop coefficient, leaf area index, FAO guide lines on evapotranspiration estimation.

UNIT V

Drainage principles, need for drainage, steady state equations, Hooghoudt, Kirkham, Dagan and Ernst equations. Salt balance, water and salt balance of the root zone, salt equilibrium equation and leaching requirement, leaching efficiency.

References:

1. Walker, W.R., and Skogerboe, G.V., "Surface Irrigation Theory and Practice", Prentice Hall, INC. 1987
2. Drainage Principles and Applications, "International Institute for Land Reclamation and Improvement", Wageningen. 1973
3. Michael, A.M., "Irrigation: Theory and Practice", Vikas Publishing House.
4. Asawa, G.L., "Irrigation Engineering", New Age International Publishers.
5. .Majumdar, D.K., “Irrigation Water Management”, PHI Learning. 2009
   6.Luthin, J.N., "Drainage Engineering", John Wiley. 1966
6. Richard H. Cuenea (1989), “Irrigation System Design (An Engineering Approach)” Published by Prentice Hall Inc

Course Outcomes (CO’s)

After completion of course work the students able to

1. Assessment of various soil properties, soil water relationships

2. Measurement of crop water requirements and infiltration
3. Management of salinity problems and leaching process.

WE15C WATER POWER ENGINEERING

L / week : 3Hrs **Sessional Marks : 40**
University Exam : 3 Hrs **End Exam Marks : 60**

UNIT -1
INTRODUCTION
Sources of energy - Development of water power in India - Advantages and disadvantages of hydropower - Estimation of water power potential- Power house components.

UNIT II

ELECTRICAL LOAD CHARACTERISTICS:

Load curve - Load factor - Capacity factor - Utilization factor - Diversity factor - Load duration curves - Firm power and secondary power load prediction.

UNIT -III

HYDROPOWER PLANTS :

Classification of hydel plants - Runoff river, valley dam, and diversion canal plants - Flow duration curves - Storage and pondage - pumped storage plants - Types - Two unit and three unit arrangements - Efficiency of pumped storage plants - Tidal power plants - Basic principle - Components - Modes of generation - Estimation of energy.

UNIT -IV

WATER CONVEYANCE SYSTEM

Intakes - Types - Hydraulic design of intakes and accessories - power canals - Penstocks - Classification - Design criteria - diameter - Anchor blocks - Design criteria - Water hammer - Surge tanks - Channel surges.

UNIT -V

HYDRAULIC TURBINES:

Selection - Setting of turbines - Cavitation in turbines – Design of Francis turbine- Design of Kaplan turbine – Design of pelton wheel – specific speed of turbine – characteristics curves of turbine.

Reference Books :

1. M.M. Dandekar and K.N.Sharma - Water Power Engineering.
2. Emmil Mosonye - Water Power Development, Vol. I & II.

Course Outcomes (Cos)

1. Able to have knowledge about different sources of energy and electrical load on hydro turbines.
2. Able to understand the concepts of low head, high head and head diversion plants
3. Able to design pumped storage power plants
4. Able to use the concepts of water conveyance
5. Able to plan a power house

WE15C URBAN HYDROLOGY

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

INTRODUCTION

Urban Hydrology - Need - Highway drainage - Rainfall Characteristics - Point rainfall for Standard Duration - Rainfall and its variability in time and space.

UNIT II

DESIGN STORM PROFILES :

Differences between urban and rural storm profiles - Recommended design procedure - Sensitivity - Storm movement.

UNIT III

FLOOD ESTIMATION :

Planning of field investigations - Measurements; Methods of flood estimation - Regional runoff rainfall model - ORSTOM model - TRRL method - Generalized tropical flood model - Effect of land use - Examples.

UNIT IV

URBAN STORM WATER DRAINAGE:

Design Criteria - Rational method - TRRL hydrograph method - HYDRAON - ILLUDAS (Illinois Urban Drainage Area Simulator) - The Walkingford procedure - The Hydrograph volume method (HVM) - Environmental Protection Agency for Storm Water Management model (SWMM).

UNIT V

PLANNING AND CONTROL MEASURES :

Urban water resources planning - Surface and subsurface drainage - Design of subsurface drains - Erosion Control - Control of Gully erosion - Control of sheet erosion.

REFERENCE BOOK :

"Highway and Urban Hydrology in Tropics" by L.H.Watkins and D. Fiddes, Pentech Publishers (London - plymouth).

Course Outcomes (COs)

After completion of the course the student will have :

1. Able to know about urban rainfall and storm water management in urban areas .
2. Able to design storm water management in urban areas
3. Able to determine the design flood for storm water drainage system.
4. Able to develop urban storm water management models and to suggest suitable erosion control measures.

WE11L ADVANCED FLUID MECHANICS LAB

P / week : 4Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

List of Practicals:

1. To study the flow behavior in a pipe bend and to calibrate the pipe bend (i.e., bend or elbow meter) for discharge measurement.
2. To study the boundary layer velocity profile, and to determine the exponent in the power law of velocity distribution, boundary layer thickness and displacement thickness.
3. To study the velocity distribution in a pipe flow and to estimate the energy and momentum correction factors.
4. To study velocity distribution and Reynolds stresses in turbulent flow

Course Outcomes (Cos)

After the completion of course the student must

1. Able to find out surface profiles in forced vortex flow
2. Able to find discharge in elbow meters
3. Able to find energy correction factor , momentum correction factor and hydraulic jump in horizontal and sloping channels.

WE12L ADVANCED HYDROLOGY LAB

P / week : 4Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

List of Practicals:

1. Downloading and processing of remote sensing products
2. The hands on experiments in the image processing, GIS platforms
3. Georeferencing of toposheet and creating vector layers(MapInfo/ArcGIS)
4. Creation of attribute tables and layout preparation (MapInfo/ArcGIS)
5. Creation of Digital Elevation Model using Vertical Mapper.
6. GPS Survey and its data transformation into GIS environment.
7. Converting *.tab file to *.shp& vice versa using Universal Translator.
8. Use of D8 pointer algorithm for deriving flow direction, flow accumulation and watershed delineation.

Course Outcomes (Cos)

After the completion of course the student must

1. Able to download the satellite data and it is imported into GIS environment
2. Able to analyse the raster data ,vector data and development of DEM
3. Able to convert GPS data into point data in GIS

WE21C ADVANCED HYDROLOGY

L / week	**: 3 Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

INTRODUCTION: Hydrologic system and hydrologic budget, fundamental laws of hydrology; atmospheric water vapour. Hydrologic Inputs: Precipitation and its forms, snowfall and rainfall; measurement techniques and space-time characteristics

UNIT II

HYDROLOGIC ABSTRACTIONS: Infiltration, depression storage, evapotranspiration; measurement techniques, space time characteristics and their modelling.

UNIT III

STREAM FLOW: Measurement techniques, space-time characteristics, rating curves System Approach: Unit Hydrograph IUH, Clark and Nash model.

UNIT IV

MATHEMATICAL MODELLING: Linear and Nonlinear models, Physically based models Hydrological routing, Flood forecasting

UNIT V

ADVANCED METHOD OF FREQUENCY ANALYSIS: Outliers, Time series analysis. Impact of climate change and Land use/Land cover on basin response

References:

1. Chow, V.T., Maidment, D.R. and Mays, W.L., "Applied Hydrology", McGraw Hill. 1988
2. Ojha, C.S.P., Berndtsson, R. and Bhunya, P., "Engineering Hydrology", Oxford University Press. 2008
3. Wanielista, M., Kersten, R. and Eaglin, R., "Hydrology", John Wiley. 1997

Course Outcomes (Cos)

After the completion of course the student must

1. To develop basic tools for analysis of hydrologic processes
2. To apply the knowledge of time series models for hydrologic data generation and forecasting.
3. To be familiar with the hydrologic design concepts and methods including estimation of the design flows
4. To assess impact of climate change and Land use/Land cover on water availability

WE22C GROUNDWATER ENGINEERING

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

INTRODUCTION

Definition of groundwater, role of groundwater in hydrological cycle, groundwater bearing formations, classification of aquifers, flow and storage characteristics of aquifers, Darcy's law, anisotropy and heterogeneity. Governing Equations for Groundwater Flow: Dupuit-Forchheimer assumptions, general differential equations governing groundwater flows, analytical solutions.

UNIT II

WELLS AND WELL HYDRAULICS

Different types of wells, construction of wells, steady and unsteady state solutions for confined, unconfined and leaky aquifers, effect of boundaries, method of images, pumping test analysis. Groundwater Conservation: Regional groundwater budget; resource assessment; estimation of recharge, Indian practice for artificial recharge

UNIT III

GROUNDWATER QUALITY

General problem of contamination of groundwater, sources, remedial and preventive measures, seawater intrusion in coastal aquifers.

UNIT IV MANAGEMENT OF GROUNDWATER

Concept of basin management – Equation of Hydrologic Equilibrium – Groundwater basin investigations – Data collection and field work – Alternative basin yields – Evaluation of perennial yield – salt balance – basin management by conjunctive use

UNIT IV

GROUNDWATER FLOW MODELLING

Role of groundwater flow models, reference to hydraulic, Hele-Shaw and analog models, introduction to numerical modeling.

References:

1. Todd, D.K., "Groundwater Hydrology", John Wiley. 1959
2. Bear, J., "Hydraulics of Groundwater", McGraw. 1979
3. Bouwer, H., "Groundwater Hydrology", McGraw Hill. 1978

4. Walton, W.C., "Groundwater Resources Evaluation", McGraw Hill. 1970 Freeze and Cherry, "Groundwater", Prentice Hall. 1979
5. Driscoll, F.G., "Ground Water and Wells", Johnson Division. 1986
6. Raghunath, H. M., "Ground Water", New Age International (P) Limited.

Course Outcomes (Cos)

After the completion of course the student must able to

1. To understand aquifer properties and movement of ground water flow after the completion of the course.
2. Able to exposure towards well design and practical problems of ground water aquifers.
3. Able to find out groundwater quality parameters
4. Able to manage the groundwater resources

WE23C COMPUTATIONAL METHODS IN FLUID MECHANICS

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Review of numerical techniques like method of characteristics, finite difference method.

Finite element method- Finite element formulation – interpolation function – one dimensional element – two dimensional elements – three dimensional elements.

UNIT II

Causes of transients in pipes, water hammer, rigid water column theory, elastic water column theory, equivalent bulk modulus of elasticity.

UNIT III

Transient open channel flow: Introduction- Examples of transient flow – Governing equation – methods of solution – method of characteristics –Explicit and implicit Finite difference method.

UNIT IV

Numerical solutions for Navier-Stokes, boundary layer and Reynolds equations.

UNIT V

Groundwater modeling, formulation of anisotropic and non homogenous flow of groundwater, finite difference methods for solving groundwater flow problems, regional groundwater flow modelling.

References:

1.Anderson, "Computational Fluid Mechanics and Heat Transfer", McGraw Hill. 1984
2. Chung, T. J., "Finite Element Analysis in Fluid Dynamics", McGraw Hill. 1978
3.Anderson, &Weessner, "Applied Groundwater Modelling", Academic Press. 1992

4.Chaudhary, H. M., "Applied Hydraulic Transient", McGraw Hill. 1976

5. Streeter and Wylie, "Fluid Transients", McGraw Hill. 1976

6. Smith, G.D., "Numerical Solution of Partial Differential Equations-FDM". 1985
7. M. Hanif Chaudhry " Applied Hydraulic transients" third edition, springer publications

Course Outcomes

1. Able to compute the various flow parameters using FDM

2. able to analyse the flow field in a variety of practical situation without going for physical model setup

3. Able to solve the groundwater flow modelling conditions.

WE23C THEORY AND APPLICATIONS OF GIS

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

INTRODUCTION, Geographical concepts and Terminology, Difference between Image Processing system and GIS, Utility of GIS. Various GIS packages and their salient features, Essentials components of GIS, Data acquisition through scanners and digitizers.

UNIT II

RASTER AND VECTOR DATA: Introduction, Descriptions: Raster and Vector data, Raster Versus Vector, Raster to Vector conversion, Remote Sensing Data in GIS, Topology and Spatial Relationships, Data storage verification and editing.

UNIT III

DATA PRE-PROCESSING, Georeferencing, Data compression and reduction techniques, Run length encoding, Interpolation of data, Database Construction, GIS and the GPS, Data Output Database structure, Hierarchical data, Network systems, Relational database, Database management, Data manipulation and analysis

UNIT IV

SPATIAL AND MATHEMATICAL OPERATIONS IN GIS, Overlay, Query based, Measurement and statistical modelling, Buffers, Spatial Analysis, Statistical Reporting and Graphing Programming languauges in GIS, Virtual GIS, Web GIS

UNIT V

APPLICATION OF GIS IN WATER RESOURCES : Land use/Land cover, Rainfall – Runoff relations and runoff potential indices of watersheds, Flood and Drought impact assessment and monitoring. Watershed management for sustainable development and Watershed characteristics – Reservoir sedimentation, Identification of suitable sites for Ground water & identification of sites for artificial recharge structures, Drainage morphometry, water depth estimation

References:

1. Burrough, P.A. and Mc Donnel, R.A., “Principles of Geographic Information System”, Oxford University Press. 2000.

2. Chrisman, Nicholas R., “Exploring Geographic Information Systems”, John Wiley. 2002

3. Demers, Michael N., “Fundamentals of Geographic Information System”, 2nd Ed. Wiley. 2008

4. Ghosh, S.K. and Chandra, A.M., “Remote Sensing and GIS”, Narosa Publishing House. 2008

5. Lo, C.P. and Young, A.K.W., “Concepts and Techniques of Geographical Information System”, Prentice Hall India. 2002

6. Longley, Paul A, Goodchild, Michael F., Maguire, David J. and Rhind, David W., “Geographic Information Systems and Science”, Wiley. 2001.

Course Outcomes

1. Able to analyse the data both in raster format and vector format

2. Able to evaluate the performance of irrigation systems

3. Able to evaluate groundwater potential using GIS and various applications in water resources engineering.

WE23C HYDROGEOLOGY AND GEOPHYSICAL EXPLORATION OF GROUNDWATER

L / week : 3Hrs **Sessional Marks : 40**
University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

INTRODUCTION :

Definitions of Hydrogeology – Interdisciplinary subject - Exploration of ground water – Aquifer properties - Porosity, permeability and hydraulic head- Direction and speed of movement of groundwater.

UNIT-II

GROUNDWATER IN DIFFERENT ROCK FORMATIONS

Rock types – Yield of groundwater from Igneous, metamorphic, sedimentary rocks, coastal deposits and glacial deposits - Groundwater indicators – Reservoir indicators – Surface indicators – Boundary indicators

UNIT – III

METHODS OF EXPLORATION- 1

Theory of electrical resistivity - Sounding and profiling - Four electrode system – Wenner and Sclumberger configuration-Cumulative resistivity method – Tagg's master curves. Electrical logging - Spontaneous potential logging - Interpretation from logs.

UNIT – IV

METHODS OF EXPLORATION - 2

Types of waves- elastic constants – Refraction method of measurement – its interpretation - Reflection method of measurement – its interpretation.Soil temperature survey – Magnetic survey – Gravity survey.

UNIT – V

METHODS OF EXPLORATION- 3

Application of Remote sensing method to delineate groundwater potential zones- thematic maps – Assessment of status of groundwater development.Radioactive logging , Induction logging, sonic logging- interpretation from logs.Drilling time, factors influencing and use of drilling time, applications of drill stem test data, wire line formation test.

Reference Books:

1. Raghunath H M (1998) "Groundwater" New Age International Publishers

2. Davis S.N. and Dewiest R.I.M. (1967) "Hydrogeology" – John Wiley sons.

3. Griffith,D.H and King R.F (1966) "Applied geophysics for Engineers and geologists" Pergamen Press.

4. Todd,D.K. (1980) "Groundwater Hydrology" John Wiley and sons, New York.

5. R.Kirsch (edited by) " Groundwater Geophysics- A tool for hydrogeology" 2nd edition, Springer Publications.

Course Outcomes (COs)

After completion of the course the student will have :

1. Able to identify different types of aquifers
2. Able to find out yield of well in different aquifers
3. Able to conduct geophysical exploration studies on groundwater identification studies
4. Applying different logging techniques in groundwater and remote sensing and gis

WE23C COASTAL ENGINEERING

L / week : 3Hrs **Sessional Marks : 40**
University Exam : 3 Hrs **End Exam Marks : 60**

UNIT -I

COASTAL ZONE PROCESS:

General, Sediment properties; measurement and sampling techniques - fundamental principles of movement - bad load and suspended load transport.

UNIT -II

Role of coastal sedimentation process - Long shore drift - Beach Evaluation Models - General sediment transport models - On-shore and off-shore sediment transport.

UNIT -III

Beach nourishment - Coast and Bed Morphology - Regime of the Coast and Sea Beach - Sand features - Features of Estuaries - Coastal and Beach features.

UNIT –IV

COASTAL PROTECTION

Identification of the problem - Restoration of the Beach - Groynes and Rivetments - Off-shore Breakwaters, Bays and Artificial Headlands - Beach replenishment.

UNIT -V

DESIGN PRINCIPLES OF COASTAL AND HARBOUR STRUCTURES :

Break water - types - Waves, Jelties and Piers; Docks - different types.

Reference Books :

1. "Coastal Hydraulics" (2nd Edn) By A.M. Muir Wood and CA Fleming, John Wiley and Sons (Newyork).
2. "Coastal Engineering" (Vol. 1 & 2) by Richard L. Silvister, Elsvier Scientific Publishing Company.

Course Outcomes (Cos)

1. Able to know Explain the properties, measurement and principles of sediment transport.
2. Able to evaluate the different sediment transport models
3. Able to describe the different features of coast and beach
4. Able to apply the knowledge of design principles of coastal and harbor structures

WE24C ENVIRONMENTAL HYDRAULICS

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Introduction and scope, review of basic principles of engineering fluid mechanics, continuity, momentum, and energy equations, steady flow through pipes- hydraulic gradient and total energy line, basics of open channel flow; Ground water, well hydraulics, well design and constructions,

UNIT II

Parallel, compound and equivalent pipes, head losses in pipes, design of pressurized conduits,

UNIT III

Various forms of mixing in the environment, modeling of the mixing process:

advection dispersion equation, Various forms of advection dispersion eq. and its solution.

UNIT IV

Special cases of mixing, density stratified flow, tide, etc.

UNIT V

Mass transfer in gas-liquid and liquid -liquid system with special emphasis on aeration, Project presentation

References:

1. Roberson, J.A., Cassidy, J.J., Chaudhry, M.H. “Hydraulic Engineering”, 2nd Edition, Wiley. 1998
2. Chadwick, A., Morfett, J., Borthwick, M. “Hydraulics in Civil and Environmental Engineering”, 5th Edition, CRC Press. 2004
3. Lee, C. C., Lin, S.D. “Handbook of Environmental Engineering Calculations”, McGraw Hill. 2007
4. Schnoor, J.L., Environmental Modeling: Fate of Chemicals in Water, Air and Soil, John Wiley & Sons, New York. 1996.

Course Outcome

1. The students will be able to gain a basic knowledge of advection-dispersion processes in the environment.

2. Able to gain the skills to take up research activities in solving environmental problems involving fluid motions.

WE24C ADVANCED NUMERICAL ANALYSIS

L / week	**: 3Hrs**	**Sessional Marks**	**: 40**
University Exam	**: 3 Hrs**	**End Exam Marks**	**: 60**

UNIT I

Introduction to digital computers & Programming an overview; Errors-Polynomial approximations and interpolations-Numerical differentiation & Integration.

UNIT II

Evaluation of single and multiple integrals, Newton's method, variational and weightened residual methods.

UNIT III

Matrices –Linear equations, Eigenvalues and Eigenvectors-nonlinear equations,

UNIT IV

Harmonic and biharmonic equations - solutions, convergence, completeness & stability.

UNIT V

Initial and boundary value problems of finite difference method, Implicit & Explicit scheme.

References

1.Jain M.K, SRK Iyenge and RK Jain."Numerical Methods for Scientific & Engg. Computation".

2.Mathews J. H “Numerical Methods for Mathematics, Science and Engineering”.

3.Gerld C.F and PO Wheatley “Applied Numerical Analysis”.

4. Gupta S.C and V. K. Kapoor “Fundamentals of Applied Statistic”, Sultan Chand & Sons.

5. Johnson R.A “ Probability and Statistics for Mngineers.

Course outcomes:

1.able to determine different variables using different numerical techniques.

WE24C RIVER WATER MANAGEMENT

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT -1

INTRODUCTION

Planning and analysis of Water Resources Systems –Probability concepts and methods.

UNIT -II

WATER RESOURCES PLANNING UNDER UNCERTAINITY

Distributions of random events - Stochastic process and time series - Planning with uncertainity - analysing systems with dynamic uncertainty.

UNIT -111

DETERMINISTIC RIVER BASIN MODELLING:

Food control alternatives - Hydro power production - Withdrawals and Diversions - Model synthesis -Expansion of water resources systems.

UNIT -IV

SYNTHETIC STREAM FLOW GENERATION:

Statistical streamflow generation models - Multisite models - Multiseasonal models - Model selection and parameter estimation - Stream flow generation from precipitation data.

UNIT -V

STOCHASTIC RIVER BASIN PLANNING MODELS

Reservoir operation - Single reservoir design and operation - Multiple - Site River Basin Planning Models.

Reference Books :

1. "Water Resources System Planning and Analysis" by Daniel P.Loucks, Jerry R. Stedinger and Douglass A. Haith (Published by Prentice - Hall Inc.)

Course outcomes:

1. Able to plane water resources projects with different uncertainties
2. Able to design the river basing modelling
3. Able to design the stochastic river basin planning models

WE24C THEORY OF SEEPAGE AND GROUNDWATER MOVEMENT

L / week : 3Hrs **Sessional Marks : 40**
University Exam : 3 Hrs **End Exam Marks : 60**

UNIT I

MOVEMENT OF GROUNDWATER

Darcy's flow - Range of validity of Darcy's law - permeability coefficient – laboratory and field methods of measurement - General hydrodynamic equation.

UNIT II

STEADY STATE FLOWS

Bboundary conditions – flow nets – construction and analysis of flow nets – flow nets for anisotropic soils.

UNIT III

UNCONFINED FLOWS

Dupuit's theory of unconfined flow – basic considerations- Two-dimensional flow on a horizontal impervious boundary - Free surface subjected Infiltration and Evaporation - groundwater flow with an inclined lower impervious boundary – Pavlosky's solutions.

UNIT IV
CONFORMAL TRANSFORMATIONS AND MAPPING TECHNIQUES
Geometrical representation of $w = f(z)$ and $z = f(w)$, application of the mapping function $z = w^2$ - Reciprocal function $w = 1/z$ - Velocity hodograph – impervious boundary – boundary of reservoir – surface of seepage –free surface– flow characteristics at singular points of flow domain – example of velocity hodograph.

UNIT V
RECHARGE OF GROUNDWATER
Concept of recharge – methods- waste water recharge for reuse – Artificial recharge for energy purposes.

References :
1. Groundwater and Seepage : M.E. Harr ,Mc Graw Hill pubs.

2. Ground water Hydrology : D.K. Todd, John Wiley & Sons

Course Outcomes (Cos)

1. Able to know about movement of groundwater
2. Able to apply the boundary conditions and flow net analysis of groundwater
3. Able to apply the principles of unconfined flow and infiltration flow of groundwater
4. Able to apply conformation transformation of mapping of groundwater
5. Able to analyze different subsurface investigations and artificial recharge techniques

WE21L Computational Fluid Dynamics

P / week	**: 4Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

List of Practicals

Exposure to software's such as ANSYS, FLUENT, creation of Geometry, Mesh, description of boundary condition and solution of flow problems in 1D, 2D and 3D. typical examples should include flow around sphere, cylinders, bridge piers etc.

Course Outcomes:

1. Able to find out boundary flow condition solution flow in 1D, 2D and 3D flows using software ANSYS, FLUENT

WE22L OPEN CHANNEL FLOW

P / week	**: 4 Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

List of Practicals:

1. To calibrate a broad-crested weir and study the pressure distribution at the upstream end of the weir.
2. To study the characteristics of a hydraulic jump.
3. To study the velocity distribution downstream of an expansion (with and without splitter plates) in a channel.
4. To obtain pressure distribution over spillway profile
5. To study energy dissipation using baffle blocks
6. To study air entrainment in open channel flow
7. To study the velocity distribution in an open channel and to estimate the energy and momentum correction factors.

Course outcomes:

1. Able to find out pressure distributions of the weir

2. Able to determine velocity distribution and pressure distribution in channels

3. Able to find out kinetic energy correction factor , momentum correction factor on horizontal and sloping channels.

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Curriculum & Syllabi for Structural Engineering

(w.e.f 2023-24)

MAY, 2023

PROGRAMME OBJECTIVES

1. To make students learn and Understand different problems Associated with Structural, geotechnical and hydraulics structures.
2. To develop analysis and design procedure for various types of structures.

PROGRAM OUTCOMES (POS):

After completion of the program graduates will be able to

1. Apply the knowledge of science, mathematics, and engineering principles for developing problem solving attitude.
2. Identify, formulate and solve engineering problems in the domain of structural engineering field.
3. Use different software tools for Analysis and Design structural engineering domain.
   Design and conduct experiments, analyse and interpret data, for development of simulation experiments.
4. Function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility.

SE11C ADVANCED STRUCTURAL ANALYSIS

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

UNIT-I

Introduction to matrix methods of analysis - statical indeterminacy and kinematical indeterminacy - degree of freedom - coordinate system - structure idealization stiffness and flexibility matrices - suitability element stiffness equations - elements flexibility equations - mixed force - displacement equations - for truss element, beam element and torsional element. Transformation of coordinates - element stiffness matrix - and load vector - local and global coordinates.

UNIT-II

Assembly of stiffness matrix from element stiffness matrix - direct stiffness method - general procedure - banded matrix - semi bandwidth - assembly by direct stiffness matrix method.

UNIT-III

Analysis of plane truss - continuous beams with and without settlement - plane frame including side sway single storey, single – bay and gable frame by flexibility method using system approach.

UNIT-IV

Analysis of plane truss - continuous beams with and without settlement - plane frame including sides sway, grids and gable frames by stiffness methods, single bay – two storey, two bay single – storey

UNIT-V

Special analysis procedures - static condensation and sub structuring - initial and thermal stresses.

References:

1. Matrix Structural Analysis by Madhu B. Kanchi.
2. Matrix Methods of Structural Analysis by J.Meek.
3. Structural Analysis by Ghali and Neyveli.
4. Structural Analysis by Devdas Menon, Narosa Publishing Housing Pvt Ltd

Course outcomes:

At the end of the course, students will be able to

1. Distinguish determinate and indeterminate structures.
2. Identify the method of analysis for indeterminate structures.
3. Apply matrix methods of analysis for continuous beams.
4. Apply matrix methods of analysis for rigid and pin jointed frames

SE12C ADVANCED SOLID MECHANICS

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

UNIT-I

INTRODUCTION TO ELASTICITY: Displacement, Strain and Stress Fields, Constitutive Relations, Cartesian Tensors and Equations of Elasticity.

STRAIN AND STRESS FIELD: Elementary Concept of Strain, Stain at a Point, Principal Strains and Principal Axes, Compatibility Conditions, Stress at a Point, Stress Components on an Arbitrary Plane, Differential Equations of Equilibrium, Hydrostatic and Deviatoric Components.

UNIT-II

EQUATIONS OF ELASTICITY: Equations of Equilibrium, Stress- Strain relations, Strain Displacement and Compatibility Relations, Boundary Value Problems, Co-axiality of the Principal Directions.

UNIT-III

TWO-DIMENSIONAL PROBLEMS OF ELASTICITY: Plane Stress and Plane Strain Problems, Airy's stress Function, Two-Dimensional Problems in Polar Coordinates.

UNIT-IV

TORSION OF PRISMATIC BARS: Saint Venant's Method, Prandtl's Membrane Analogy, Torsion of Rectangular Bar, Torsion of Thin Tubes.

UNIT-V

PLASTIC DEFORMATION: Strain Hardening, Idealized Stress- Strain curve, Yield Criteria, von Mises Yield Criterion, Tresca Yield Criterion, Plastic Stress-Strain Relations, Principle of Normality and Plastic Potential, Isotropic Hardening.

References:

1. Theory of Elasticity, Timoshenko S. andGoodierJ. N., McGraw Hill, 1961.
2. Elasticity,SaddM.H.,Elsevier,2005.
3. Engineering Solid Mechanics, RagabA.R., BayoumiS.E., CRC Press,1999.
4. Computational Elasticity, AmeenM., Narosa,2005.
5. Solid Mechanics, KazimiS. M. A., Tata McGraw Hill,1994.
6. Advanced Mechanics of Solids, SrinathL.S., Tata McGraw Hill,2000.

Course outcomes: At the end of the course, students will be able to

1. Solve simple problems of elasticity and plasticity understanding the basic concepts.
2. Apply numerical methods to solve continuum problems.

3. Study the two-dimensional problems of Elasticity.

4. Solving the tensional problem of prismatic beam.

5. Solve the problems of plasticity understanding the basic concepts.

SE13C DESIGN OF PRESTRESSED CONCRETE STRUCTURES

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Contents

UNIT-I

INTRODUCTION TO PRESTRESSED CONCRETE: types of prestressing, systems and devices, materials, losses in prestress. Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads, ultimate strength in flexure, code provision.

UNIT-II

TRANSMISSION OF PRESTRESS: Pretensioned members; Anchorage zone stresses for post tensioned members, Short term and Long term PSC beams

UNIT-III

STATICALLY DETERMINATE PSC BEAMS: Analysis and Design for ultimate and serviceability limit states for flexure, shear and torsion, code provisions.

UNIT-IV

STATICALLY INDETERMINATE STRUCTURES - Analysis and design - continuous beams and frames, choice of cable profile, linear transformation and concordancy.

UNIT-V

COMPOSITE CONSTRUCTION with precast PSC beams and cast in-situ RC slab - Analysis and design, creep and shrinkage effects. Partial prestressing - principles, analysis and design concepts, crack-width calculations. Analysis and design of pre stressed concrete pipes

References:

1. Design of Prestressed Concrete Structures, Lin T.Y., Asia Publishing House, 1955.
2. Prestressed Concrete, Krishnaraju N., Tata McGraw Hill, New Delhi, 1981.
3. Limited State Design of Prestressed Concrete, GuyanY., Applied Science Publishers, 1972.
4. IS: 1343- Code of Practice for Prestressed Concrete
5. IRC: 112

Course outcomes: At the end of the course, students will be able to

1. Find out losses in the prestressed concrete. Understand the basic aspects of prestressed concrete fundamentals, including pre and post-tensioning processes.
2. Analyse prestressed concrete deck slab and beam/ girders.
3. Design prestressed concrete deck slab and beam/ girders.
4. Design of end blocks for prestressed members.

.

SE14C ADVANCED STEEL DESIGN

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Contents:

UNIT-I

PROPERTIES OF STEEL: Mechanical Properties, Hysteresis, Ductility.

HOT ROLLED SECTIONS: compactness and non-compactness, slenderness, residual stresses.

UNIT-II

DESIGN OF STEEL STRUCTURES: Inelastic Bending Curvature, Plastic Moments, Design Criteria Stability, Strength, Drift.

STABILITY OF BEAMS: Local Buckling of Compression Flange &Web, Lateral Torsional Buckling.

UNIT-III

STABILITY OF COLUMNS: Slenderness Ratio, Local Buckling of Flanges and Web, Bracing of Column about Weak Axis.

METHOD OF DESIGNS: Allowable Stress Design, Plastic Design, Load and Resistance Factor Design;

UNIT-IV

STRENGTH CRITERIA: Beams - Flexure, Shear, Torsion, Columns - Moment Magnification Factor, Effective Length, PM Interaction, Biaxial Bending, Joint Panel Zones.

DRIFT CRITERIA: P Effect, Deformation Based Design;

UNIT-V

CONNECTIONS: Welded, Bolted, Location Beam Column, Column Foundation, Splices.

Reference Books

1. Design of Steel Structures - Vol. II, Ramchandra. Standard Book House, Delhi.

2. Design of Steel Structures - Arya A. S., Ajmani J. L., Nemchand and Bros., Roorkee.

3. The Steel Skeleton- Vol. II, Plastic Behaviour and Design - Baker J. F., Horne M. R., Heyman J., ELBS.

4. Plastic Methods of Structural Analysis, Neal B. G., Chapman and Hall London. IS 800: 2007 – General Construction in Steel - Code of Practice, BIS, 2007.

5. SP – 6 - Handbook ofStructural Steel Detailing, BIS,198

Course Outcomes: At the end of the course, students will be able to

1. Design steel structures/ components by different design processes.

2. Analyze and design beams and columns for stability and strength, and drift.

3. Design welded and bolted connections

SE14C THEORY AND APPLICATIONS OF CEMENT COMPOSITES

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Content:

UNIT-I

INTRODUCTION: Classification and Characteristics of Composite Materials- Basic Terminology, Advantages. Stress-Strain Relations- Orthotropic and Anisotropic Materials, Engineering Constants for Orthotropic Materials, Restrictions on Elastic Constants, Plane Stress Problem, Biaxial Strength, Theories for an Orthotropic Lamina.

UNIT-II

MECHANICAL BEHAVIOUR: Mechanics of Materials Approach to Stiffness- Determination of Relations between Elastic Constants, Elasticity Approach to Stiffness- Bounding Techniques of Elasticity, Exact Solutions - Elasticity Solutions with Continuity, Halpin, Tsai Equations, Comparison of approaches to Stiffness.

UNIT-III

CEMENT COMPOSITES: Types of Cement Composites, Terminology, Constituent Materials and their Properties, Construction Techniques for Fibre Reinforced Concrete - Ferro cement, SIFCON, Polymer Concretes, Preparation of Reinforcement, Casting and Curing.

MECHANICAL PROPERTIES OF CEMENT COMPOSITES: Behaviour of Ferro cement, Fibre Reinforced Concrete in Tension, Compression, Flexure, Shear, Fatigue and Impact, Durability and Corrosion.

UNIT-IV

APPLICATION OF CEMENT COMPOSITES: FRC and Ferro cement- Housing, Water Storage, Boats and Miscellaneous Structures. Composite Materials- Orthotropic and Anisotropic behaviour, Constitutive relationship, Elastic Constants.

UNIT-V

ANALYSIS AND DESIGN OF CEMENT COMPOSITE STRUCTURAL ELEMENTS - Ferro cement, SIFCON and Fibre Reinforced Concrete.

Reference Books:

1. Mechanics of Composite Materials, Jones R. M,, 2nd Ed., Taylor and Francis,BSP Books, 1998. Ferro cement – Theory and Applications, Pama R. P., IFIC, 1980.
2. New Concrete Materials, Swamy R.N., 1stEd., Blackie, Academic and Professional, Chapman & Hall, 1983.

Course Outcomes: At the end of the course, students will be able to

1. Formulate constitutive behaviour of composite materials – Ferrocement, SIFCON and Fibre Reinforced Concrete - by understanding their strain- stress behaviour.
2. Classify the materials as per orthotropic and anisotropic behaviour.
3. Estimate strain constants using theories applicable to composite materials.
4. Analyse and design structural elements made of cement composites.

SE14C THEORY OF STRUCTURAL STABILITY

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Contents:

UNIT-I

CRITERIA FOR DESIGN OF STRUCTURES: Stability, Strength, and Stiffness, Classical Concept of Stability of Discrete and Continuous Systems, Linear and nonlinear behaviour.

UNIT-II

STABILITY OF COLUMNS: Axial and Flexural Buckling, Lateral Bracing of Columns, Combined Axial, Flexural and Torsion Buckling.

UNIT-III

STABILITY OF FRAMES: Member Buckling versus Global Buckling, Slenderness Ratio of Frame Members.

UNIT-IV

STABILITY OF BEAMS: lateral torsion buckling.

UNIT-V

STABILITY OF PLATES: Axial, flexural, buckling, shear, flexural, buckling, buckling under combined loads. Introduction to Inelastic Buckling and Dynamic Stability.

Reference Books:

1. Theory of elastic stability, Timoshenko and Gere, Tata Mc Graw Hill,1981
2. Principles of Structural Stability Theory, Alexander Chajes, Prentice Hall, New Jersey.
3. Structural Stability of columns and plates, Iyengar, N. G. R., Eastern west press Pvt. Ltd. Strength of Metal Structures,Bleich F. Bucking, Tata McGraw Hill, New York.

Course Outcomes: At the end of the course, students will be able to

1. Use stability criteria and concepts for analysing discrete and continuous systems,

2. Determine stability of beams and plates
3. Determine stability of columns and frames
4. Determine stability of plates.

SE14C ANALYTICAL AND NUMERICAL METHODS FOR STRUCTURAL ENGINEERING

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Contents:

UNIT-I

FUNDAMENTALS OF NUMERICAL METHODS: Error Analysis, Polynomial Approximations and Interpolations, **Curve Fitting;** Interpolation and extrapolation. Solution of nonlinear algebraic and transcendental equations

UNIT-II

ELEMENTS OF MATRIX ALGEBRA: Solution of Systems of Linear Equations, Eigen Value Problems.

UNIT-III

NUMERICAL DIFFERENTIATION & INTEGRATION: Solution of Ordinary and Partial Differential Equations.

UNIT-IV

INITE DIFFERENCE SCHEME: Implicit & Explicit scheme.

UNIT-V

COMPUTER ALGORITHMS: Numerical Solutions for Different Structural Problems, Fuzzy Logic and Neural Network.

Reference Books:

1. An Introduction to Numerical Analysis, AtkinsonK.E., J. Wiley and Sons, 1989.
2. Theory and Problems of Numerical Analysis, Scheid F, McGraw Hill Book Company, (Shaum Series), 1988.
3. Introductory Methods of Numerical Analysis, Sastry S. S, Prentice Hall of India, 1998.

Course Outcomes: At the end of the course, students will be able to

1. Analyse the error analysis, polynomial approximations & curve fittings.
2. Write solutions of systems of linear equations & given value problems.
3. Solve ordinary and partial differential equations in structural mechanics using numerical methods.
4. Write a program to solve a mathematical problem.

SE15C STRUCTURAL HEALTH MONITORING

L / L / week : 3Hrs Sessional Marks : 40

University Exam : 3 Hrs End Exam Marks : 60

Syllabus Contents:

UNIT-I

STRUCTURAL HEALTH: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance.

UNIT-II

STRUCTURAL HEALTH MONITORING: Concepts, Various Measures, Structural Safety in Alteration.

STRUCTURAL AUDIT: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.

UNIT-III

STATIC FIELD TESTING: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.

UNIT-IV

DYNAMIC FIELD TESTING: Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.

UNIT-V

INTRODUCTION TO REPAIRS AND REHABILITATIONS OF STRUCTURES: Case Studies (Site Visits), piezo– electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.

Reference Books:

1. Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006.
2. Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.
3. Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006.
4. Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc, 2007.

Course Outcomes: At the end of the course, students will be able to

1. Diagnosis the distress in the structure understanding the causes and factors.
2. Assess the health of structure using static field methods.
3. Assess the health of structure using dynamic field tests.
4. Suggest repairs and rehabilitation measures of the structure.

SE15C QUALITY CONTROL AND SAFETY MANAGEMENT

L / L / week : 3Hrs Sessional Marks : 40

University Exam : 3 Hrs End Exam Marks : 60

Syllabus Contents:

UNIT-I

Types Of Organizations: Inspection. Control And Enforcement -Quality Management Systems And Method - Responsibilities And Authorities In Quality Assurances And Quality ControlArchitects, Engineers, Contractors, And Special Consultants, Quality Circle. Quality Systems : Introduction - Quality System Standard – ISO 9000 Family Of Standards – Requirements – Preparing Quality System Documents – Quality Related Training – Implementing A Quality System – Third Party Certification

UNIT-II

Quality Policy: Objectives And Methods In Construction Industry -Consumers Satisfaction, Economics- Time Of Completion -Statistical Tolerance -Taguchi's Concept Of Quality. Codes And Standards -Documents -Contract And Construction Programming -Inspection Procedures - Processes And Products -Total QA I QC Programme And Cost Implication.

UNIT-III

Regularity Agent, Owner, Design, Contract And Construction Oriented Objectives, Methods - Techniques And Needs Of QA/QC -Different Aspects Of Quality - Appraisals, Factors Influencing Construction Quality.

UNIT-IV

Critical, Major Failure Aspects And Failure Mode Analysis -Stability Methods And Tools, Optimum Design -Reliability Testing- Reliability Coefficient And Reliability Prediction – Selection Of New Materials -Influence Of Drawings Detailing, Specification, Standardization-Bid PreparationReliability Based Design.

UNIT-V

Construction Activity And Environmental Safety: Social And Environmental Factors- Natural Causes And Speed Of Construction -Life Cycle Costing- Reliability And Probabilistic MethodsValue Engineering And Value Analysis

Reference Books:

1. Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006.
2. Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.
3. Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006.
4. Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc, 2007.

Course Outcomes: At the end of the course, students will be able to

1. Diagnosis the distress in the structure understanding the causes and factors.
2. Assess the health of structure using static field methods.
3. Assess the health of structure using dynamic field tests.
4. Suggest repairs and rehabilitation measures of the structure.

SE15C MAINTENANCE AND REHABILITATION OF STRUCTURES

L / L / week : 3Hrs Sessional Marks : 40

University Exam : 3 Hrs End Exam Marks : 60

Syllabus Contents:

UNIT-I

Influence On Serviceability And Durability: General : Quality Assurance For Concrete Construction, As Built Concrete Properties, Strength, Permeability, Volume Changes, Thermal Properties, Cracking. Effects Due To Climate, Temperature, Chemicals, Wear And Erosion, Design And Construction Errors, Corrosion Mechanism, Effects Of Cover Thickness And Cracking Methods Of Corrosion Protection, Inhibitors, Resistant Steels, Coatings Cathodic Protection.

UNIT-II

Maintenance And Repair Strategies: Inspection, Structural Appraisal, Economic Appraisal, Components Of Equality Assurance, Conceptual Bases For Quality Assurance Schemes..

UNIT-III

Materials For Repair: Special Concretes And Mortar, Concrete Chemicals, Special Elements For Accelerated Strength Gain, Expansive Cement, Polymer Concrete, Sulphur Infiltrated Concrete, Ferro Cement, Fibre Reinforced Concrete.

UNIT-IV

Techniques For Repair : Rust Eliminators And Polymers Coating For Rebars During Repair, Foamed Concrete, Mortar And Dry Pack, Vacuum Concrete, Gunite And Shotcrete Epoxy Injection, Mortar Repair For Cracks, Shoring And Underpinning.

UNIT-V

Case Studies : Repairs To Overcome Low Member Strength, Deflection, Cracking, Chemical Disruption, Weathering, Wear, Fire, Leakage, Marine Exposure.

Reference Books:

1. Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006.
2. Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.
3. Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006.
4. Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc, 2007.

Course Outcomes: At the end of the course, students will be able to

1. Diagnosis the distress in the structure understanding the causes and factors.
2. Assess the health of structure using static field methods.
3. Assess the health of structure using dynamic field tests.
4. Suggest repairs and rehabilitation measures of the structure.

SE15C FRACTURE MECHANICS OF CONCRETE STRUCTURES

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Contents:

UNIT-I

INTRODUCTION: Basic Fracture Mechanics, Crack in a Structure, Mechanisms of Fracture and Crack Growth, Cleavage Fracture, Ductile Fracture, Fatigue Cracking.

UNIT-II

FRACTURE MECHANISM:

UNIT-III

STRESS AT CRACK TIP: Stress at Crack Tip, Linear Elastic Fracture Mechanics, Griffith's Criteria, Stress Intensity Factors, Crack Tip Plastic Zone, Erwin's Plastic Zone Correction, R curves, Compliance, J Integral, Concept of CTOD and CMD.

UNIT-IV

MATERIAL MODELS: General Concepts, Crack Models, Band Models, Models based on Continuum Damage Mechanics, Applications to High Strength Concrete, Fibre Reinforced Concrete.

UNIT-V

Environment assisted Cracking, Service Failure Analysis, Crack Concepts and Numerical Modelling.

Reference Books:

1. Fracture Mechanics, Suri C. T. and Jin Z.H., 1st Edition, Elsevier Academic Press, 2012.
2. Elementary Engineering Fracture Mechanics, BroekDavid, 3rd Rev. Ed. Springer, 1982.
3. Fracture Mechanics of Concrete Structures – Theory and Applications, Elfgreen L., RILEM Report, Chapman and Hall, 1989.
4. Fracture Mechanics – Applications to Concrete, Victor, Li C., Bazant Z. P., ACI SP 118, ACI Detroit, 1989.

.

Course outcomes: At the end of the course, students will be able to

1. Identify and classify cracking of concrete structures based on fracture mechanics.
2. Implement stress intensity factor for notched members
3. Apply fracture mechanics models to high strength concrete and FRC structures.
4. Compute J-integral for various sections understanding the concepts of LEFM.

SE21C FINITE ELEMENT METHOD IN STRUCTURAL ENGINEERING

L / week : 3Hrs Sessional Marks : 40
University Exam : 3 Hrs End Exam Marks : 60

Syllabus Contents:

UNIT-I

Introduction: Concepts of FEM –Steps Involved –Merits &Demerits –Energy Principles – Discretization –Rayleigh –Ritz Method of Functional Approximation.

Elastic Formulations: Stress Equations-Strain Displacement Relationships in Matrix Form-Plane Stress, Plane Strain and AxiSymmetric Bodies of Revolution With Axi Symmetric Loading

UNIT-II

One Dimensional -FEM-Stiffness Matrix for Beam and Bar Elements Shape Functions for ID Elements –Static Condensation of Global Stiffness Matrix-Solution –Initial Strain and Temperature Effects.

UNIT-III

Two Dimensional FEM: Different Types of Elements for Plane Stress and Plane Strain Analysis – Displacement Models –Generalized Coordinates-Shape Functions-Convergent and Compatibility Requirements –Geometric Invariance –Natural Coordinate System-Area and Volume CoordinatesGeneration of Element Stiffness and Nodal Load Matrices –Static Condensationalerkin Finite Element Method, Application to Structural Elements, Interpolation Functions, Compatibility and Completeness Requirements, Polynomial Forms, Applications.

UNIT-IV

Isoparametric Formulation-Concept, Different Isoparametric Elements for 2D AnalysisFormulation of 4-Noded and 8-Noded Isoparametric Quadrilateral Elements – Lagrangian ElementsSerendipity Elements. Axi Symmetric Analysis –Bodies of Revolution-Axi Symmetric Modelling – Strain Displacement Relationship-Formulation of Axi Symmetric Elements.

UNIT-V

Three Dimensional FEM-Different 3-D Elements, 3D Strain –Displacement RelationshipFormulation of Hexahedral and Isoparametric Solid Element

Reference Books:

1. Finite Element Analysis, Seshu P., Prentice-Hall of India,2005.
2. Concepts and Applications of Finite Element Analysis, Cook R. D., Wiley J., New York, 1995. Fundamentals of Finite Element Analysis, Hutton David, Mc-Graw Hill, 2004.
3. Finite Element Analysis, Buchanan G.R., McGraw Hill Publications, New York, 1995. Finite Element Method, Zienkiewicz O.C. & Taylor R.L. Vol. I, II & III, Elsevier, 2000.
4. Finite Element Methods in Engineering, Belegundu A.D., Chandrupatla, T.R., Prentice Hall India, 1991.

Course Outcomes: At the end of the course, students will be able to

1. Use Finite Element Method for structural analysis.
2. Execute the Finite Element Program/ Software.
3. Solve continuum problems using finite element analysis.
4. Develop the FEM software.

SE22C STRUCTURAL DYNAMICS

L/week : 3Hrs Sessional Marks : 40

University Exam : 3 Hrs End Exam Marks: 60

UNIT - I

RESPONSE OF SIMPLE – SINGLE DEGREE OF FREEDOM SYSTEM - Definition of DOF – Idealization of structure as SDOF system – Formulation of equations of motion for various SDOF systems – Free vibration of un-damped systems – Determination of natural frequency - Free vibration of viscously damped systems – Determination of Damping in structures.

UNIT - II

RESPONSE OF SINGLE DEGREE OF FREEDOM SYSTEMS- FORCED VIBRATIONS -

Forced vibration of systems – Steady state response to harmonic forces – Duhamel's integral-Numerical Evaluation – Response to support motion – Transmissibility – Construction of response Spectrum.

UNIT - III

ANALYSIS OF MULTI-DEGREE OF FREEDOM SYSTEMS - Formal Derivations — Formulation of equation of motion - Evaluation of natural frequencies and modes — Free vibration of undamped systems — Forced vibration of damped systems.

UNIT — IV

APPROXIMATE METHODS OF COMPUTING NATURAL FREQUENCIES - Rayleigh's method – Dunkerley's method – Methods of iteration – Stodola – Vainello Method –Rayleigh – Ritz method.

UNIT — V

DYNAMIC ANALYSIS OF CONTNUOUS SYSTEM - Vibration of flexural beams — Equation of motion — Free vibrations of Uniform Beams - Natural frequencies and Mode Shapes of Beams with different Support Conditions - Orthogonality Condition between Normal Modes.

References :

1. Dynamics of Structures, Clough R.W, and Penzien J, McGraw Hill.
2. Structural Dynamics and Introduction to Earthquake Engineering, Chopra A K, Prentice Hall.
3. Vibrations of Structures – Application in Civil Engg Design, Smith J. W.Chapman and Hall.
4. Dynamics of Structures, Humar J L, Prentice Hall.
5. Structural Dynamics - Theory and Computation, Paz Mario, CBS Publication.

Course Outcomes: At the end of the course, students will be able to

1. Analyze the dynamic response of single degree freedom system usinging fundamental theory and equation of motion.
2. Analyze dynamic response of Multi-degree of freedom system with lumped parameters.
3. Apply approximate methods to obtain fundamental natural frequency of structures.
4. Analyze dynamics response of Multi degree of freedom system with distributed mass.

SE23C THEORY OF THIN PLATES AND SHELLS

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Contents:

UNIT-I

INTRODUCTION: Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using Principle of Virtual Work, Boundary Conditions.

UNIT-II

STATIC ANALYSIS OF PLATES: Governing Equation for a Rectangular Plate, Navier Solution for Simply- Supported Rectangular Plate under Various Loadings, Levy solution for Rectangular Plate with other Boundary Conditions.

UNIT-III

CIRCULAR PLATES: Analysis under Axi- Symmetric Loading, Governing Differential Equation in Polar Co-ordinates. Approximate Methods of Analysis- Rayleigh-Ritz approach for Simple Cases in Rectangular Plates.

UNIT-IV

STATIC ANALYSIS OF SHELLS: MEMBRANE THEORY OF SHELLS - Cylindrical, Conical and Spherical Shells,

UNIT-V

SHELLS OF REVOLUTION: WITH BENDING R**ESISTANCE** - Cylindrical and Conical Shells, Application to Pipes and Pressure Vessels.

References:

1. Theory of Plates and Shells, Timoshenko S. and KriegerW., McGraw Hill.
2. Stresses in Plates and Shells, UguralAnsel C., McGraw Hill.
3. Thin Elastic Shells, KrausH., John Wiley and Sons.
4. Theory of Plates, Chandra shekhar K., Universities Press.
5. Design and Construction of Concrete Shells, Ramaswamy G.S.

Course Outcomes: At the end of the course, students will be able to

1. Use analytical methods for the solution of thin plates and shells.
2. Use analytical methods for the solution of shells.
3. Apply the numerical techniques and tools for the complex problems in thin plates.
4. Apply the numerical techniques and tools for the complex problems in shells.

SE23C DESIGN OF BRIDGES

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Contents:

UNIT-I

Introduction – Classification, Investigations and Planning, Choice of Type – Economic Span Length – IRC Specifications for Road Bridges, Standard Live Loads, Other Forces Acting on Bridges, General Design Considerations.

UNIT-II

Design of Box Culverts – General Aspects – Design Loads – Design Moments, Shears and Thrusts – Design of Critical Section.

Design of Slab Bridges – Effective Width of Analysis – Workings Stress Design and Detailing of Slab Bridges for IRC Loading.

UNIT-III

T-Beam Bridges – Introduction – Wheel Load Analysis – B.M. in Slab – Pigaud's Theory –

Analysis of Longitudinal Girders by Courbon's Theory Working Stress Design and Detailing of Reinforced Concrete T-Beam Bridges for IRC Loading.

UNIT-IV

Prestressed Concrete Bridges – General Features – Advantages of Prestressed Concrete Bridges – Pre-tensioned Prestressed Concrete Bridges – Post Tensioned Prestressed Concrete Bridge Decks. Design of Post Tensioned Prestressed Concrete Slab Bridge Deck. Bridge Bearings – General Features – Types of Bearings – Forces on Bearings Basis for Selection of Bearings – Design Principles of Steel Rocker and Roller Bearings and Its Design – Design of Elastometric Pad Bearing Detailing of Elastomeric Pot Bearings.

UNIT-V

Piers and Abutments – General Features – Bed Block – Materials for Piers and Abutments – Types of Piers – Forces Acting on Piers – Design of Pier – Stability Analysis of Piers – General Features of Abutments – Forces Acting on Abutments – Stability Analysis of Abutments

References:

- Concrete Bridge Design, Browe, R.E., C.R.Books Ltd., London, 1962.
- Reinforced Concrete Bridges, Taylor F.W., Thomson, S.E., and Smulski E., John Wiley and Sons, New York, 1955.
- An Introduction To Structural Design of Concrete Bridges, Derrick Beckett, Surrey University; Press, Henlely – Thomes, Oxford Shire, 1973
- Bridge Analysis Simplified, Bakht.B.And Jaegar, L.G. Mc Graw Hill, 1985.
- Design of Bridges – N.Krishna Raju – Oxford & IBH 6. Design of Bridge Structures – FR Jagadeesh, M.A. Jaya Ram – Eastern Economy Edition.

Course Outcomes: At the end of the course, students will be able to

- Finalize with the usage of codal provisions in the design of bridges
- Analyze and design substructure elements of bridges
- Analyze and design various types of bridges like t-beam bridge,slab bridge ,box culvert.
- To analyze and design of T beam bridge

SE23C DESIGN OF HIGH RISE STRUCTURES

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Content:

UNIT-I

DESIGN OF TRANSMISSION/ TV TOWER, MAST AND TRESTLES: Configuration, bracing system, analysis and design for vertical transverse and longitudinal loads.

UNIT-II

ANALYSIS AND DESIGN OF RC AND STEEL CHIMNEY, Foundation design for varied soil strata.

UNIT-III

TALL BUILDINGS: Structural Concept, Configurations, various systems, Wind and Seismic loads,

UNIT-IV

Dynamic approach, structural design considerations and IS code provisions. Firefighting design provisions.

UNIT-V

APPLICATION of software in analysis and design.

Reference Books:

1. Structural Design of Multi-storeyed Buildings, Varyani U. H., 2nd Ed., SouthAsian Publishers, New Delhi, 2002.
2. Structural Analysis and Design of Tall Buildings, Taranath B. S., Mc Graw Hill, 1988.
3. Illustrated Design of Reinforced ConcreteBuildings(GF+3storeyed), Shah V. L. &Karve S. R., Structures Publications, Pune, 2013.
4. Design of Multi Storeyed Buildings, Vol. 1 & 2, CPWD Publications, 1976. Tall Building Structures, Smith Byran S. and Coull Alex, Wiley India. 1991. High Rise Building Structures, Wolfgang Schueller, Wiley., 1971.
5. Tall Chimneys, Manohar S. N., Tata Mc Graw Hill Publishing Company, New Delhi

Course Outcomes: At the end of the course, students will be able to

1. Analyse, design and detail Transmission/ TV tower, Mast and Trestles with different loading conditions.
2. Analyse, design and detail the RC and Steel Chimney.
3. Analyse. design and detail the tall buildings subjected to different loading conditions using relevant codes.

4. Analysis and design of dynamic approach OF STRUCTURAL DESIGN USING is Code provisions.

SE23C DESIGN OF EARTHQUAKE RESISTANT STRUCTURES

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Content:

UNIT-I

Engineering Seismology : Earthquake – Causes of Earthquake – Earthquakes and Seismic Waves – Scale and Intensity of Earthquakes – Seismic Activity – Measurements of Earth Quakes – Seismometer- Strong Motion Accelerograph / Field Observation of Ground Motion – Analysis of Earthquakes Waves – Earth Quake Motion – Amplification of Characteristics of Surface Layers – Earthquake Motion on The Ground.

UNIT-II

Vibration of Structures Under Ground Motion: Elastic Vibration of Simple Structures – Modelling of Structures and Equations of Motion – Free vibrations of Simple Structures – Steady State Forced Vibrations – Non Steady State Forced Vibrations – Response Spectrum Representations; Relation Between The Nature of The Ground Motion and Structural Damage.

UNIT-III

Lateral Force Procedure Seismic Base Shear – Seismic Design Co-Efficient - Vertical Distribution of Seismic Forces and Horizontal Shear – Twisting Moment - Over Turning Moment – Vertical Characteristics Effect – SoilΔSeismic Load and Orthogonal Effects Lateral Deflection – P- Structure Interaction. Seismic – Graphs Study, Earthquake Records for Design – Factors Affecting Accelerogram Characteristics - Artificial Accelerogram – Zoning Map. Dynamic – Analysis Procedure: Model Analysis – Inelastic – Time History Analysis Evaluation of the Results.

UNIT-IV

Earthquake – Resistant Design of Structural Components and Systems: Introduction – Monolithic Reinforced – Concrete Structures – Precast Concrete Structures – Prestressed Concrete Structures – Steel Structures – Composite – Structures, Masonry Structures – Timber Structures

UNIT-V

Fundamentals of Seismic Planning: Selection of Materials and Types of Construction Form of Superstructure – Framing Systems and Seismic Units – Devices for Reducing. Earthquake Loads.

Reference Books:

1. Design of Earthquake Resistant Structures by Minoru Wakabayashi.
2. Strucutural Dynamics for Earthquake Engineering", A.K.Chopra,Pearson Pubilications.
3. Dynamics of Structures. R.W.Clough, Mc Graw – Hill, 2nd Edition,

Course Outcomes: At the end of the course, students will be able to

- Illustrate the measurement of earthquakes and their effect on engineering structures
- Analyse the free and forced vibration response of single degree and multi degree of freedom and continuous systems
- Apply the basic principles of conceptual design of Earthquake Resistant buildings
- Learn the various seismic control methods

SE24C DESIGN OF ADVANCED CONCRETE STRUCTURES

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Content:

UNIT – I ESTIMATION OF CRACK WIDTH AND REDISTRIBUTION OF MOMENTS IN REINFORCED CONCRETE BEAMS :

Factors affecting crack width in beams - Calculation of crack width - Empirical Method - Estimation of crack width in beams by IS 456 - Shrinkage and thermal cracking - Redistribution of moments in a fixed beam and a two-span continuous beam - Advantage and disadvantages of moment redistribution.

UNIT – II DESIGN OF RIBBED (VOIDED) SLABS & GRID FLOORS :

Analysis of the ribbed slabs for moment and shears - Design for shear - Deflections - Arrangement of reinforcements.

Analysis of grid floors by Timoshenko's plate theory, stiffness matrix method - Equating joint deflections - Detailing of steel.

UNIT – III DESIGN OF PLAIN CONCRETE WALLS :

Braced and unbraced walls - Eccentricities of vertical loads - Empirical design method (walls carrying axial load) - Design of wall for In-plane horizontal forces.

DESIGN OF DEEEP BEAMS :

Steps of designing deep beams by IS 456 - Detailing of deep beams.

UNIT – IV EARTH QUAKE FORCES AND STRUCTURAL RESPONSE :

Earthquake magnitude and intensity - Determination of design forces - Torsion in buildings - Ductile detailing of beams - Columns and frame members with axial force and moment.

UNIT – IV DESIGN OF SHEAR WALLS :

Classification of shear walls - Loads in shear walls - Design of rectangular and flanged shear walls - Moment of resistance of rectangular shear walls

Reference Books:

1) P.C.Varghese, "Advanced Reinforced Concrete Design", Prentice-Hall of India, Private Ltd., New Delhi.

2) P.C.Varghese, "Limit State Design of Reinforce Concrete", Prentice-Hall of India Private Ltd., New Delhi.

3) Krishna Raju, "Advanced Reinforced Concrete Design - SI Units" CBS, New Delhi, 1986.

4) Blume, J.A., Newmark, N.M. and Corning, L.M. "Design of Multi-Storey Reinforced Concrete Buildings for Earth Quake Motion", Portland Cement Association, Chicogo, 1961.

5) Pankaj Agarwal, "Earthquake Resistant Structures", Prentice-Hall of India, Private Ltd. New Delhi.

Course Outcomes: At the end of the course, students will be able to

1. Model the loads and findings the material properties.
2. Design deep beams and corbels
3. Design of shear walls using IS, ACI & Errocode.
4. Analyse the special structures by understanding their behaviour in torsional buckling.
5. Design and prepare detail structural drawings for execution citing relevant IS codes.

SE24C ADVANCED CONSTRUCTION TECHNIQUES

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Content:

UNIT – I

Construction Techniques: Box Jacking -Pipe Jacking - Under Water Construction Of Diaphragm Walls And Basement. Tunneling Techniques. Piling Techniques - Driving Well And Caisson - Sinking Cofferdam - Cable Anchoring And Grouting. Driving Diaphragm Walls Sheet Piles - Laying Operations For Built Up Offshore System - Shoring For Deep - Well Points - Dewatering And Stand By Plant Equipment For Underground Open Excavation - Trenchless Technology.

UNIT – II

Techniques For Concreting: Techniques Of Construction For Continuous Concreting Operation In Tall Buildings Of Various Shapes And Varying Sections Launching Techniques - Slipform Techniques- Suspended Form Work-. Erection Techniques Of Tall Structures - Launching Techniques For Heavy Decks -In Situ Prestressing In High Rise Structures, Aerial Transporting Handling Erecting Lightweight Components On Tall Structures - Erection Of Lattice Towers And Rigging Of Transmission Line Structures.

UNIT – III

Construction Sequence And Methods: Bow String Bridges, Cable Stayed Bridges. Launching And Pushing Of Box Decks. Construction Sequence And Methods In Domes And Prestressed Domes. Vacuum Dewatering Of Concrete Flooring - Concrete Paving Technology- Erection Of Articulated Structures.

UNIT – IV

Construction Techniques For Foundation: Mud Jacking Grout Through Slab Foundation - Micro Piling For Strengthening Floor And Shallow Profile Pipeline Laying - Protecting Sheet Plies, Screw Anchors - Sub Grade Water Proofing Under Pinning Advanced Techniques And Sequence In Demolition And Dismantling.

UNIT – V

Fundamentals Of Energy: Energy Production Systems -Heating. Ventilating And Air.

Conditioning -Solar Energy And Conservation -Energy Economic Analysis -Energy Conservation And Audits Domestic Energy Consumption -Savings- Challenges -Primary Energy Use In Buildings - Residential. Commercial -Institutional And Public Buildings

Reference Books:

1. Practical Foundation Engineering Hand Book, Robertwade Brown, Mcgraw Hill Publications, 1995
2. Construction Dewatering: New Methods And Applications, Patrick Powers .J, John Wiley & Sons, 1992

Course Outcomes: At the end of the course, students will be able to

- Gain an experience in the implementation of new construction technology on engineering concepts which are applied in field Advanced construction technology.
- Get a diverse knowledge of Advanced technology practices applied to real life problems.
- Understand the theoretical and practical aspects of new technology in civil engineering along with the design and management applications.
- Study of construction equipments, and temporary works required to facilitate the construction process

SE24C LOW COST HOUSING TECHNIQUES

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Content:

UNIT – I

Housing Scenario Introduction - Status of Urban Housing - Status of Rural Housing Housing Finance: Introducing - Existing Finance System in India - Government Role As Facilitator - Status At Rural

Housing Finance - Impedimently in Housing Finance and Related Issues

Land Use and Physical Planning for Housing Introduction - Planning of Urban Land - Urban Land Ceiling and Regulation Act - Efficiency of Building Bye Lass - Residential Densities

Housing The Urban Poor Introduction - Living Conditions in Slums - Approaches and Strategies for Housing Urban Poor

UNIT – II

Development and Adoption of Low Cost Housing Technology

Introduction - Adoption of Innovative Cost Effective Construction Techniques - Adoption of Precast Elements in Partial Prefatroices - Adopting of Total Prefactcation of Mass Housing in India- General Remarks on Pre Cast Rooting/Flooring Systems -Economical Wall System - Single Brick Thick Loading Bearing Wall - 19cm Thick Load Bearing Masonery Walls - Half Brick Thick Load Bearing Wall - Flyash Grypsym Thick for Masonry - Stone Block Masonery - Adoption of Precast R.C. Plank and Join System for Roof/Floor in The Building

UNIT – III

Alternative Building Materials for Low Cost Housing Introduction - Substitute for Scarce Materials – Ferrocement - Gypsum Boards - Timber Substitutions - Industrial Wastes - Agricultural Wastes - Fitire Starateru; for ,P,Topm of Alternative Building Maintenance

Low Cost Infrastructure Services: Introduce - Present Status - Technological Options - Low Cost Sanitation - Domestic Wall - Water Supply, Energy

UNIT – IV

Rural Housing: Introduction Traditional Practice of Rural Housing Continuous - Mud Housing Technology Mud Roofs - Characteristics of Mud - Fire Treatment for Thatch Roof - Soil Stabilization - Rural Housing Programs

UNIT – V

Housing in Disaster Prone Areas: Introduction – Earthquake - Damages To Houses -

Traditional Prone Areas - Type of Damages and Railways of Non-Engineered Buildings - Repair and Restore Action of Earthquake Damaged NonEngineered Buildings Recommendations for Future Constructions. Requirement's of Structural Safety of Thin Precast Roofing Units Against Earthquake Forces, Status of R&D in Earthquake Strengthening Measures - Floods, Cyclone, Future Safety

Reference Books:

3. Properties of Concrete – Neville A.M. Pitman Publishing Limited, London.
4. Light Weight Concrete, Academic Kiado, Rudhai.G – Publishing Home of Hungarian Academy of Sciences 1963.
5. Low Cost Housing – G.C. Mathur

Course Outcomes: At the end of the course, students will be able to

- Development of construction technology and innovative techniques as tools to address demand mass construction
- Knowledge of eco friendly material with their application
- Learn the use of locally available material according to their availability and maintenance

SE24C DESIGN OF INDUSTRIAL STRUCTURES

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Contents:

UNIT-I

Chimneys – Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration, design of base plate, design of foundation bolts, design of foundation.

UNIT-II

Water Tanks – Design of rectangular riveted steel water tank – Tee covers – Plates – Stays –

Longitudinal and transverse beams –Design of staging – Base plates – Foundation and anchor bolts.

UNIT-III

Design of pressed steel water tank – Design of stays – Joints – Design of hemispherical bottom water tank – side plates – Bottom plates – joints – Ring girder –Design of staging and foundation.

Reference Books:

1. Design of Steel Structure, Punmia B. C., Jain Ashok Kr., Jain Arun Kr., 2nd Ed., Lakshmi Publishers, 1998.
2. Design of Steel Structures, Ram Chandra, 12th Ed., Standard Publishers, 2009. Design of Steel Structures, Subramaniyam.

Course Outcomes: At the end of the course, the student will be able to:

- Design Steel Gantry Girders.
- Design Steel Portal, Gable Frames.
- Design Steel Bunkers and Silos.
- Design Chimneys and Water Tanks.

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502
Department of Chemical Engineering-Scheme of Instruction- (CBCS) effective from the Academic Year 2023-2024

M.Tech (PG) Specialization: Chemical Engineering -- I Semester

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC-1	CH11C	Advanced Transport Phenomena	3	1	0	4	4	40	60	100
PCC-2	CH12C	Separation Processes	3	1	0	4	4	40	60	100
PCC-3	CH13C	Chemical Reactor Theory	3	1	0	4	4	40	60	100
PEC-I	CH14C	Programme Elective Course - I	3	0	0	3	3	40	60	100
PEC-II	CH15C	Programme Elective Course- II	3	0	0	3	3	40	60	100
PCC-I Lab	CH16L	Computational Techniques Lab	0	0	3	3	1.5	40	60	100
PCC-II Lab	CH17L	Advanced Chemical Engg. Lab	0	0	3	3	1.5	40	60	100
MC		Research Methodology and IPR	3	0	0	3	3	40	60	100
	Total		18	03	06	27	24	320	480	800

Course Code	List of Programme Elective Course I	Course Code	List of Programme Elective Course II
1	Process Design and Synthesis	1	Industrial Pollution Control
2	Fluidization Engineering	2	Transport in porous media
3	Process Plant Simulation	3	Chemo-Informatics
4	Computational Fluid Dynamics	4	Advanced Control Systems

II Semester

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Internal Marks	End Sem Marks	Total
PCC-4	CH21C	Membrane Separations	3	1	0	4	4	40	60	100
PCC-5	CH22C	Optimization Theory and Practice	3	1	0	4	4	40	60	100
PEC-III	CH23C	Programme Elective Course- III	3	0	0	3	3	40	60	100
PEC-IV	CH24C	Programme Elective Course- IV	3	0	0	3	3	40	60	100
PCC-III Lab	CH25L	Steady State Simulation Lab	0	0	3	3	1.5	40	60	100
PCC-IV Lab	CH26L	Advanced Instrumentation Lab	0	0	3	3	1.5	40	60	100
MC		Industrial Safety	3	0	0	3	3	100	-	100
PCC		Mini Project with Seminar	0	0	4	4	2	100	-	100
	Total		**15**	**02**	**10**	**27**	**22**	**440**	**360**	**800**

Course Code	List of Programme Electives-III	Course Code	List of Programme Electives IV
1	Modern Concepts in Catalysis & Surface Phenomenon	1	Phase Transitions in Process Equipment
2	Advanced Downstream Processing	2	Process Intensification
3	Process Synthesis and Analysis	3	Micro flow chemistry& Process Technology
4	Micro and Nano Fluids	4	Process Plant Design & Flow settling Tools

Note: 1. Students are allowed to do Open Elective Course through online (MOOCS)/ NPTEL and can select the subjects that are not covered in the Curriculum and twelve (12) weeks in duration. However, the obtained pass certificate should be submitted at the last instruction day of the IIIrd semester course work ant the results will reflect in IIIrd semester Marks MEMO

III Semester

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
OEC	CH31C	Open Elective Course (MOOCs)	0	0	0	0	3	100	-	100
PCC	CH32C	Industrial/Research Internship(Min of 4 Weeks)	0	0	0	0	3	100	-	100
PCC	CH33D	**Dissertation Work Phase-I**	0	0	24	24	12	40(guide)	60(Internal committee)	100
	Total		**0**	**0**	**24**	**24**	**18**	**240**	**60**	**300**

IV Semester

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	CSP41J	**Dissertation Work Phase-II and Viva-Voce**	0	0	20	20	16	40	60	100
	Total		**0**	**0**	**20**	**20**	**16**	**40**	**160**	**100**

Semester	**I**	**II**	**III**	**IV**	**Total**
Credits	**24**	**22**	**18**	**15**	**80**

R-23

M.Tech. Program Regulations

Scheme of Instruction & Syllabus

(Effective from the Batch Admitted in 2020-2021)



DEPARTMENT OF CHEMICAL ENGINEERING

S V UNIVERSITY COLLEGE OF ENGINEERING

TIRUPATI- 517502

CH11C ADVANCES IN TRANSPORT PHENOMENA

Instruction , hours/week : 3 Credits : 3 Assessment : 40 + 60

Objectives:

1. To familiarize the student with basic concepts of transport phenomena and brief review of mathematics.
2. To enable students to understand the equations of change for isothermal flow and for non-isothermal flow.
3. To introduce them details of equations of change for multi component systems.
4. To give them insight into properties of two-dimensional flows and aspects of dimensional analysis

Unit-1: Equations of Change for Isothermal Systems: Equation of Continuity, Equation of Motion, Equation of Mechanical Energy, Equations of Change in terms of the Substantial Derivative, Use of the Equations to solve Flow Problems, Dimensional Analysis of the Equations of Change. Velocity Distributions with more than one Independent Variable: Time Dependent Flow of Newtonian Fluids. Velocity Distributions in Turbulent Flow - Comparisons of Laminar and Turbulent Flows, Time Smoothed Equations of Change for Incompressible Fluids, Time Smoothed Velocity Profile near a wall, Empirical Expressions for the Turbulent Momentum Flux, Turbulent Flow in Ducts, Turbulent Flow in Jets.

Unit-2: Macroscopic Balances for Isothermal Systems: The Macroscopic Mass Balance, The Macroscopic Momentum Balance, The Macroscopic Mechanical Energy Balance, Estimation of the Viscous loss, Use of the Macroscopic Balances for Steady-State Problems, Derivation of the Macroscopic Mechanical Energy Balance.
Equations of Change for Non-Isothermal Systems: The Energy Equation, Special forms of the Energy Equation, The Boussine sq Equation of Motion for Forced and Free Convection, Use of the Equations of change to Solve Steady-State Problems, Dimensional Analysis of the Equations of Change for Non-Isothermal Systems.

Unit-3: Temperature Distributions in Solids and in Laminar Flow: Heat Conduction with an Electrical Heat Source, Heat Conduction with a Viscous Heat Source. Temperature Distributions with more than One Independent Variable - Unsteady Heat Conduction in Solids, Steady Heat Conduction in Laminar, Incompressible Flow. Temperature Distributions in Turbulent Flow - Time-Smoothed Equations of Change for Incompressible Non-Isothermal Flow, Time-Smoothed Temperature Profile near a Wall, Empirical Expressions for the Turbulent Heat Flux Temperature Distribution for Turbulent Flow in Tubes.

Unit-4: Macroscopic Balances For Non-Isothermal Systems: Macroscopic Energy Balance, Macroscopic Mechanical Energy Balance, Use Of The Macroscopic Balances To Solve Steady State Problems With Flat Velocity Profiles, Concentration Distributions in Solids and in Laminar Flow: Shell Mass Balances Boundary Conditions, Diffusion through a Stagnant Gas Film, Diffusion with a Heterogeneous Chemical Reaction. Concentration Distributions with more than One Independent Variable: Time-Dependent Diffusion, Steady-State Transport in Binary Boundary Layers, Concentration Distributions in Turbulent Flow -

Concentration Fluctuations and the Time-Smoothed Concentration, Time-Smoothing of the Equation of Continuity of A, Semi-Empirical Expressions for the Turbulent Mass Flux, Enhancement of Mass Transfer by a First-Order Reaction in Turbulent Flow.

Unit -5: Interphase Transport in Multi-Component Systems: Definition of Transfer Coefficients inOne Phase, Analytical Expressions for Mass Transfer Coefficients, Correlation of Binary Transfer Coefficients in One Phase, Definition of Transfer Coefficients in Two Phases, Mass Transfer and Chemical Reactions. Macroscopic Balances For Multi-Component Systems: Macroscopic Mass Balances, Macroscopic Momentum, Use of the Macroscopic Balances to solve Steady-State Problems.

References

1) Thomson W. J., Transport Phenomena, Pearson education, Asia, 2001.

2) Geankopolis C. J., Transport Processes and Unit Operations, 4th Ed., Prentice Hall (India) Pvt. Ltd., New Delhi. 2004.

3) Bird R. B., Stewart W. E. and Light Foot E. N., Transport Phenomena, Revised 2nd Edition, John Wiley & Sons, 2007.

Outcomes: At the end of the course, the student will be able to:

1. Understand the mechanism of momentum, heat and mass transport for steady and unsteady flow.
2. Perform momentum, energy and mass balances for a given system at macroscopic and microscopic scale.
3. Solve the governing equations to obtain velocity, temperature and concentration profiles.
4. Model the momentum, heat and mass transport under turbulent conditions.
5. Develop analogies among momentum, energy and mass transport.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	2								1
CO2	1	2	3	2	2							1
CO3		2	2	3		1						1
CO4		1	3	2								1
CO5		2	2	2	1							1

CH12C SEPARATION PROCESSES

Instruction , hours/week : 3 Credits : 3 Assessment : 40 + 60

Objectives:

1) Understand the classification of separation processes
2) To learn the fundamental concepts of rate governed processes
3) To impart the basic concepts of multistage separation processes
4) Understand the design of distillation column using different methods
5) Understand the energy requirements of different separation processes

UNIT I

Use and Characteristics of Separation Processes – Importance and variety of Separations – Characteristics of separation Processes- Inherent separation factors for equilibrium and rate Governed Processes

Simple equilibrium processes: Equilibrium calculations- Checking phase conditions for a mixture- Analysis of simple equilibrium separation-processes for binary and multi component systems - Computational and Graphical Approaches.

Unit II

Additional Factors Influencing Product Purities – Incomplete Mechanical Separation of Product Phases – Flow Configuration and Mixing Effects – Batch Operations – Methods of Regeneration – Mass and Heat Transfer Limitations – Stage Efficiencies

Multistage Separation Processes: Increasing product purity - Reducing consumption of separating agent - co-current, crosscurrent and countercurrent flow - Other separation processes - Fixed bed processes.

Unit-III:

Binary Multistage Separations - Distillation: Binary Systems - Equilibrium stages and McCabe-Thiele Diagram - design and other problems – Multistage batch distillation - Straight operating lines and curved operating lines.

UNIT IV

Patterns of Change: Binary and Multi component multistage separations

Group Methods - Linear stage-exit relationships and constant flow rates- non linear stage – Exit Relationships and varying flow rates.

Capacity of contacting devices: factors limiting capacity and factors influencing efficiency.

UNIT V

Energy Requirements of separations processes:

Thermodynamic efficiency - single stage and multistage separation processes - reduction of energy consumption**.**

Selection of Separation processes: Factors influencing the choice of separation Process - solvent extraction and Illustrative examples

TEXT BOOKS:

1. Separation Processes - C.Judson King,, McGraw – Hill, 1982

REFERENCE BOOKS

1. Separation Process Principles - J.D.Seader and E.J.Henley, , John Wiley, 1998.
2. Mass Transfer Operation - R.E. Treybal, , 3rd edition - McGraw – Hill 1980
3. Transport Processes and Unit Operations – Geankoplis C.J. 4th ed – PHI Pvt. Ltd

Course Outcomes: Student will be able to

1) Applies the concepts of diffusion mass transfer, mass transfer coefficients, convective mass transfer, inter-phase mass transfer, equipment for gas-liquid operations
2) Suggest and design equipment for various mass transfer operations
3) Study of the stage wise mass transfer operations, principles of various stage wise contact processes like distillation
4) Student will be able to select a separation process for a particular system.
5) Able to understand the energy requirements of separation processes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1			1	1	1			1	1			
CO2				1	2							
CO3			2	1								
CO4			1		2			1	1			
CO5				1	1				1			

CH13C CHEMICAL REACTOR THEORY

Instruction , hours/week : 3 Credits : 3 Assessment : 40 + 60

Course Educational Objectives:

1) The emphasis of this course is on the fundamentals of chemical reaction kinetics and chemical reactor operation.
2) The overall goal of this course is to develop a critical approach toward understanding complex reaction systems and elucidating chemical reactor design.
3) Integrate concepts from science & engineering to constitute a basis for the design of chemical reactor, a key element in the design of chemical process.
4) Provide a foundation on Non-ideal reactors and RTD
5) Impart knowledge about heterogeneous catalytic reactors

UNIT I

Isothermal Reactor design: Design structure for isothermal reactors - Scale-up of liquid phase batch reactor data to the design of a CSTR - Tubular reactors - Pressure drop in Reactors - Reversible reactions - unsteady state operation of reactors -Simultaneous reaction and Separation.

UNIT-II

Analysis of Non ideal Reactors - RTD - Measurement and characteristics of RTD- RTD in ideal reactors - Reactor modeling with the RTD - Zero and One parameter models - Two-Parameter model - Modeling real reactors with combinations of ideal reactors - Testing a model and determining it's parameters - Other models of non ideal reactors using CSTRs and PFRs

UNIT-III

External diffusion Effect on Heterogeneous Reactions - Binary diffusion - External resistance to mass transfer - the shrinking core model.

Diffusion and reaction in Porous Catalyst – Diffusion and reaction in spherical pellets - Internal Effectiveness factor - Falsified Kinetics - Overall effectiveness factor - Estimation of diffusion and reaction limited regimes - Mass transfer and reaction in a packed bed

UNIT-IV

Internal Transport Processes-Reaction and Diffusion in porous catalysts:

Intra pellet mass transfer and intra pellet heat transfer, Mass transfer with reaction, Mass and Heat transfer with reaction, effect of internal transport on selectivity and poisoning.

UNIT-V

Design of heterogeneous Catalytic Reactors: Fixed bed reactors and isothermal and adiabatic fixed-bed reactors, non isothermal, non adiabatic fixed bed reactors, Two phase model, Fluidized-Bed reactors, Operating characteristics of FBRs. Mass Transfer in Fluidized Beds: Gas-Solid Mass Transfer, Mass Transfer between the Fluidized-Bed Phases, Reaction in Fluidized Bed. Trickle bed reactor Models, Slurry reactor models.

Text Books

1. J.M.Smith "Chemical Engineering Kinetics" 3rd ED., Mc Graw Hill, New York 1980
2. Fogler H. S., Elements of Chemical Reaction Eng.", 3rd Ed., Prentice Hall, 1999
3. Levenspiel, O., "Chemical Reaction Eng." John Wiley & Sons 1972.

Course Outcomes : Student will be able to

1) learn the importance of RTD and Non-ideal flow in reacting vessels.
2) Calculate the conversions based on segregated flow model, dispersion model and tanks-in-series models.
3) Understand the diffusion and reaction in a porous catalyst.
4) Learn the factors influencing catalyst decay, the role of pore diffusion on catalyst activity rate.
5) Understand the design of heterogeneous catalytic reactors.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1			1	1	1			1				2
CO2			1		2			1	2			
CO3				1	1			1	1			1
CO4			1	2					1			2
CO5				1					1			

CH16L COMPUTATIONAL TECHNIQUES LABORATORY

Instruction , hours/week : 4 Credits : 2 Assessment : 40 + 60

Objectives:

1. To learn Numerical methods for interpolation, extrapolation, graphical differentiation and integration, curve fitting….Process Modeling and Simulation of Chemical operations and processes.
2. To implement the above on MAT Lab

List of experiments:

1.Euler Method

2. Runge Kutta 4th Order Method

3. Jacobi Iteration Method

4. Gauss-Siedel Iteration Method

5. Lagrange's Iteration Method

6. Newton Forward Interpolation Method

7. Newton Backward Interpolation Method

8, Bisection Method

9. Newton Raphson Method

10. Regula Falsi Method

Outcomes: At the end of the course, the student will be able to:

1. Use numerical methods for various manipulations and be capable of implementing them on a computing system.

CH17L ADVANCED CHEMICAL ENGINEERING LABORATORY

Instruction , hours/week : 4 Credits : 2 Assessment : 40 + 60

PGPC01 Research methodology and IPR

Instruction Hours/Week : 3 Credits : 3
Sessional Marks : 40 End Semester Examination Marks : 60

DESCRIPTION OF THE COURSE:

This subjects gives how to proceed systematically for research, present research findings. This course consists of basics of research methods, paper writing , patenting methods and requirements..

COURSE EDUCATIONAL OBJECTIVES (CEOs):

1. To understand the importance of research objectives and procedures
2. To know the procedures of data collection and report writing of research.
3. To have the knowledge of filing and obtaining a patent on research findings.

UNIT I

Meaning, Objective and Motivation in Research: Types of Research, Research Approaches, Research Process, Validity and Reliability in Research, Research Design: Features of Good Design, Types of Research Design, Basic Principles of Experimental Design

UNIT II

Sampling Design: Steps in Sampling Design, Characteristics of a Good Sample Design, Random Samples and Random Sampling Design Measurement and Scaling Techniques: Errors in Measurement, , Scaling and Scale Construction techniques, Forecasting Techniques, Time Series Analysis, Interpolation and Extrapolation

UNIT III

Methods of Data Collection: Primary Data, Questionnaire and Interviews, Collection of Secondary Data, Cases and Schedules. Professional Attitude and Goals, Concept of Excellence, Ethics in Science and Engineering, Correlation and Regression Analysis, Method of Least Squares, Regression Vs. Correlation, Correlation Vs. Determination.

UNIT IV

Interpretation of Data and Report Writing, Layout of a Research Paper, Techniques o f Interpretation. Making Scientific Presentation at Conferences and Popular Lectures to Semi Technical Audience, Participating in Pubic Debates on Scientific Issues

UNIT V

Nature of Intellectual property rights, Patents, designs, trademarks and copyrights, History of patenting, process of patenting, patent development, international cooperation on IPR, procedure of granting patent, patent rights, licensing and transferring technology, Geographical Indications ,IPR in biological and systems and software.

Text/Reference Books:

1. Research Methodology: Methods And Techniques - C. R. Kothari,2nd Edition, New Age International Publishers.
2. Statistical Methods - S P. Gupta. S. chand & Sons, New Derhi.
3. Intellectual ProPerty-the law of trademarks, copyrights, Patents, and trade Secrets-Deborah E. Bouchoux, Esq.Georgetown University, Fourth edition

Course Outcomes (COs):

1.Able to know research importance and requirements and procedure
2. Able to apply sampling techniques for analysis and forecasting.
3. Able to use methods for data collection and analyze the data using different mathematical techniques.
4. Able to write report on research done and present the research findings in systematic manner.
5. Able to have the knowledge to file and obtain patent on research finding.

CH14C PROCESS DESIGN AND SYNTHESIS

Instruction , hours/week : 3 Credits : 3 Assessment : 40 + 60

Objectives:

1. To understand the systematic approaches for the development of conceptual chemical process designs

2. To learn the advances in problem formulation and software capabilities which offer the promise of a new generation of practical process synthesis techniques based directly on structural optimization.

3. Learning chemical process synthesis, analysis, and optimization principles

4. Product design and development procedure and Process life cycle assessment.

Unit I : Introduction

Introduction to fundamental concepts and principles of process synthesis and design and use of flow sheet simulators to assist process design. Process Flow sheet Models: An Introduction to Design, Chemical process synthesis, analysis and optimization. Introduction to commercial process design software such as HYSYS, Aspen plus etc., Chemical Process (reactor, heat exchanger, distillation etc) analysis using commercial software

Unit II : Product design and developments

Process engineering economics and project evaluation Life Cycle Assessments of process: From design to product development, Engineering Economic Analysis of Chemical Processes, Project costing and performance analysis, Environmental concerns, Green engineering, Engineering ethics, Health and safety.

Unit III : Reactor Networks

Geometry of mixing and basic reactor types, The Attainable Region (AR) approach, AR in higher dimensions & for other processes, Reactive Separation processes, Fundamental behavior and problems, Separation through reactions. Reactive Residue Curve Maps

Unit IV : Synthesis of Separation Trains

Criteria for selection of separation methods, select ion of equipment**:** Absorption, Liquid-liquid extraction Membrane separation, adsorption, leaching, drying, crystallization, Ideal distillation - Column and sequence fundamentals, Sharp splits & sequencing Phase diagrams for 2, 3 and 4 components, Feasibility and vapor ow rates for single columns, Residue curve basics, Non-ideal Distillation - Azeotropic systems; detecting binary azeotropes, Residue curve maps for azeotropic systems, Topological analysis, Feasibility for single azeotropic columns ,Binary VLLE and pressure-swing separation, Non-ideal distillation synthesis. Equipment sequencing: VLE + VLLE, Detailed Residue Curve Maps, Residue curve maps: Interior structure

Unit V : Heat Exchanger Network Synthesis

Minimum heating and cooling requirements, Minimum Energy Heat Exchanger Network, Loops and Paths, Reducing Number of Exchangers, HENS basics & graphics, The pinch point approach, Stream Splitting, Performance targets, trade-off & utilities, Heat & power integration, HENS as mathematical programming

References

1. Douglas, J. "Conceptual Design of Chemical Processes",New York, NY: McGraw-HillScience/Engineering/Math, 1988. ISBN: 0070177627.

2. Seider, W. D., J. D. Seader, and D. R. Lewin. "Product and Process Design Principles: Synthesis, Analysis, and Evaluation",. 2nd ed. New York, NY: Wiley, 2004. ISBN: 0471216631.

3. Richard Turton, Richard C. Bailie, Wallace B. Whiting, Joseph A. Shaeiwitz., "Analysis, Synthesis, and Design of Chemical Processes", 2nd Edition, 2002, Prentice Hall ISBN-10: 0-13-064792-6

4. Biegler L.T., Grossmann I.E. and Westerberg A.W., "Systematic Methods of Chemical Process Design", Prentice Hall, 1997.

Outcomes: At the end of the course, the student will be able to

1. Analyze alternative processes and equipment
2. Synthesize a chemical process flow sheet that would approximate the real process
3. Design best process flow sheet for a given product
4. Perform economic analysis related to process design and evaluate project profitability
5. Heat Exchanger Network Synthesis

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	2								
CO2	1			2								
CO3			2			1						
CO4		1		2								
CO5				2	1							

CH14C FLUIDIZATION ENGINEERING

Instruction , hours/week : 3 Credits : 3 Assessment : 40 + 60

Objectives

1. To study the phenomenon of fluidization with industrial processing objective
2. To study the various regimes of fluidization and their mapping.
3. To study the design of equipments based on fluidization technique

Unit I : Introduction to fluidization and applications

Phenomenon of fluidization, behavior of fluidized bed, contacting modes, advantages and disadvantages of fluidization, fluidization quality, selection of contacting mode, Beds for Industrial applications, coal gasification, synthesis reactions, physical operations, cracking of hydrocarbons

Unit II : Mapping of fluidization regimes

Characterization of particles, mechanics of flow around single particles, minimum fluidization velocity, pressure drop versus velocity diagram, The Geldart classification of solids, fluidization with carryover of particles, terminal velocity of particles, distributor types, gas entry region of bed, pressure drop requirements, design of gas distributor, power consumption

Unit III : Bubbling fluidized beds

Davidson model for bubble in a fluidized bed, and its implications, the wake region and movement of solids at bubbles, coalescence and splitting of bubbles, bubble formation above a distributor, slug flow, Turbulent and fast fluidization - mechanics, flow regimes and design equations, Emulsion movement, estimation of bed properties, bubble rise velocity, scale up aspects, flow models, two phase model, K-L model

Unit IV : Solids movement and Gas dispersion

Vertical and horizontal movement of solids, Dispersion model, large solids in beds of smaller particles, staging of fluidized beds

Gas dispersion in beds, gas interchange between bubble and emulsion, estimation of gas interchange coefficient, Heat and mass transfer in fluidized systems, Mixing in fluidized systems - measurements and models.

Unit V : Fluidized bed reactors

Entrainment and elutriation, Freeboard behavior, gas outlet, entrainment from tall vessel, freeboard entrainment model, high velocity fluidization, pressure drop in turbulent and fast fluidization, Slugging, Spouted beds, Circulating Fluidized Beds.

Mathematical model of a homogeneous fluidized bed, Design of catalytic reactors, pilot plant reactors, information for design, bench scale reactors, design decisions, deactivating catalysts, Design of non catalytic reactors, kinetic models for conversion of solids, models for shrinking particles, conversion of solids of unchanging size]

References

1. Levenspiel O. and Kunnii D., “Fluidization Engineering”, John Wiley, 1972
2. Liang-Shih Fan, “Gas-Liquid-Solid Fluidization Engineering”, Butterworths, 1989

Course Outcomes: At the end of the course, the student will be able to:

1. Performing and understanding the behavior fluidization in fluidized bed
2. Evaluate the characterization of particles and power consumption in fluidization regimes
3. Understanding the applicability of the fluidized beds in chemical industries
4. Dispersion model, large solids in beds of smaller particles, staging of fluidized beds,Gas dispersion in beds.
5. Entrainment and elutriation,Mathematical model of a homogeneous fluidized bed.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1			1		1			1				
CO2			1	1	2							
CO3					1			1				
CO4			1		2							
CO5			1	1				1				

CH14C **PROCESS PLANT SIMULATION**

Instruction : 3 hr/week Credits : 3 Evaluation : 40 + 60

Course Objectives ; Students will have to learn the following

1) Learn the Chemical Systems Modeling and Artificial Neural Networks
2) Understand how to design Steady State Extraction and Heat Conduction through Hollow Cylindrical, Unsteady State Mass Balance for CSTR and Heat Transfer in a Tubular Gas Pre Heater
3) Understand how to design models from Fluid Flow and Reaction Engineering
4) Develop Errors of Measurement, Problems in Data Regression and Solving Equation Solving and Modular Approach
5) Develop Algorithms based on Signal Flow Graph, Tearing Algorithms and Physical and Thermodynamic Properties of Convergence Promotion

UNIT I

Modeling Aspects: Deterministic vs. Stochastic Processes, Physical modeling, Mathematical modeling, Chemical Systems Modeling, Cybernetics, Controlled System, Principles of Similarity

Classification of Mathematical Modeling: Independent and Dependent variables, Classification based on variation of independent variables, Classification based on state of the process, Classification based on type of the process, Boundary Conditions, The black Box Principle, Artificial Neural Networks

UNIT II - Process Modeling - I

Models from mass transfer: steady state single stage solvent extraction, steady state two stage solvent extraction, steady state two stage cross current solvent extraction, , steady state N-stage solvent counter current extraction, unsteady state single stage solvent extraction, unsteady state mass balance in a stirred tank and in a mixing tank.

Models from Heat Transfer : steady state heat conduction through a hollow cylindrical pipe, unsteady state steam heating of a liquid, unsteady state heat loss through a measuring tank, heat transfer through extended surfaces, unsteady state heat transfer in a tubular gas pre heater

UNIT III – Process Modeling -II

Models from fluid flow: flow through a packed bed column, flow of a film on the outside of a circular tube, annular flow with inner cylinder moving axially, flow between coaxial cylinders and concentric spheres

Models from Reaction Engineering : chemical reaction with diffusion in a tubular reactor, chemical reactor with heat transfer in a packed bed reactor, gas absorption accompanied by chemical reaction

UNIT IV

Error Propagation & Data Regression :Propagation of errors through addition, subtraction, multiplication and division, Errors of measurement, Precision errors, errors method

Data Regression : Theoretical properties, data regression methods, Problems in data regression

Process Simulation : Modular Approach, The equation solving approach

UNIT V

Decomposition of Networks : Tearing Algorithms, Algorithms based on signal flow graph and reduced digraph

Convergence Promotion: Newton's method, direct substitution method, Wegstein's method, dominant Eigen value method, quasi Newton method, Criterion for acceleration, Physical and Thermodynamic Properties

TEXTBOOKS:

1. Process Plant Simulation, B.V.Babu, Oxford University press, 2004
2. Process Modeling, Simulation and Control for Chemical Engineers, 2nd ed., W. L. Luyben, McGraw-Hill, New York, 1990

REFERENCE:

1. Introduction to Numerical Methods in Chemical Engineering, P. Ahuja, PHI , New Delhi, 2010
2. Process Modeling and Simulation, Amiya K. Jana, 2012.

Course Objectives : Students will be trained in

1) Modelling Aspects and Classification of Mathematical Modelling
2) How to Prepare Models from Mass Transfer and Models on Heat Transfer
3) How to Prepare Models from Fluid Flow and Models on Reaction Engineering
4) The analysis through Propagation of Errors, Error Methods, Data Regression Methods and Process Simulation
5) Decomposition of Networks and Convergence Promotion

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1			1		1			1				
CO2			1	1	2							
CO3					1			1				
CO4			1		2							
CO5			1	1				1				

CH14C COMPUTATIONAL FLUID DYNAMICS

Instruction , hours/week : 3 Credits : 3 Assessment : 40 + 60

Objectives

1. To make students understand the governing equations of fluid dynamics and their derivation from laws of conservation
2. To develop a good understanding in computational skills, including discretisation, accuracy and stability.
3. To acquaint the students with a process of developing a mathematical and geometrical model of flow, applying appropriate boundary conditions and solving system of equations

Unit I : Introduction to Fluid Dynamics

Concepts of Fluid Flow, Pressure distribution in fluids, Reynolds transport theorem, Integral form of conservation equations, Differential form of conservation equations, Different Types of Flows, Euler and Navier Stokes equations, Properties of supersonic and subsonic flows, Flow characteristics over various bodies. Philosophy of CFD, Governing equations of fluid dynamics and there physical meaning, Mathematical behavior of governing equations and the impact on CFD simulations, Simple CFD techniques and CFL condition. Numerical Methods in CFD: Finite Difference, Finite Volume, and Finite Element, Upwind and downwind schemes, Simple and Simpler schemes, Higher order methods, Implicit and explicit methods, Study and transient solutions

Unit II : Grid Generation

Basic theory of structured grid generation, Surface grid generation, Mono block, multi block, hierarchical multi block, Moving and sliding multiblock, Grid clustering and grid enhancement. Basic theory of unstructured grid generation, advancing front, Delaunay triangulation and various point insertion methods, Unstructured quad and hex generation, grid based methods, various elements in unstructured grids, Surface mesh generation, Surface mesh repair, Volume grid generation, Volume mesh improvement, mesh smoothing algorithms, grid clustering and quality checks for volume mesh. Adaptive, Moving and Hybrid Grids, Need for adaptive and, moving grids, Tet, pyramid, prism, and hex grids, using various elements in combination

Unit III : Turbulence and its Modeling

Transition from laminar to turbulent flow, Effect of turbulence on time-averaged Navier-Stokes equations, Characteristics of simple turbulent flows, Free turbulent flows, Flat plate boundary layer and pipe flow, Turbulence models, Mixing length model,The k-e model, Reynolds stress equation models, Algebraic stress equation models

Unit IV : Chemical Fluid Mixing Simulation

Stirred tank modeling using the actual impeller geometry, Rotating frame model, The MRF Model Sliding mesh model, Snapshot model, Evaluating Mixing from Flow Field Results, Industrial Examples

Unit IV : Post-Processing of CFD results

Contour plots, vector plots, and scatter plots, Shaded and transparent surfaces, Particle trajectories and path line trajectories, Animations and movies, Exploration and analysis of data.

References

1. Anderson John D., "Computational Fluid Dynamics: The Basics with Applications", Mc Graw Hill, 1995
2. Ranade V.V., "Computational Flow Modeling for Chemical Reactor Engineering", Process Engineering Science, Volume 5, 2001
3. Knupp Patrick and Steinberg Stanly, "Fundamentals of Grid Generation", CRC Press, 1994
4. Wilcox D.C., "Turbulence Modelling for CFD", 1993
5. Wesseling Pieter, "An Introduction to Multigrid Methods", John Wiley & Sons, 1992
6. Thompson J.F., Warsi Z.U.A. and Mastin C.W., "Numerical Grid Generation: Foundations and Applications", North Holland, 1985
7. Patankar S.V., "Numerical Heat Transfer and Fluid Flow", McGraw-Hill,1981
8. Gatski Thomas B., Hussaini M. Yousuff and Lumley John L., "Simulation and Modelling of Turbulent Flows", Oxford University Press, 1996
9. Laney, C. B., "Computational Gas Dynamics", Cambridge Uni. Press, 1998.

Outcomes: At the end of the course, the students will be able to:

1. Understand the basic principles of mathematics and numerical concepts of fluid dynamics.
2. Develop governing equations for a given fluid flow system.
3. Adapt finite difference techniques for fluid flow models.
4. Apply finite difference method for heat transfer problems.
5. Solve computational fluid flow problems using finite volume techniques. Get familiarized to modern CFD software used for the analysis of complex fluid-flow systems

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1			1	1	1			1	1			
CO2			2	1				1	2			1
CO3			1	1	1			2	1			2
CO4			1		2			1	1			1
CO5			1	1	1			1	1			1

CH15C **INDUSTRIAL POLLUTION CONTROL**

Instruction , hours/week : 3 Credits : 3 Assessment : 40 + 60

Objectives

1. To understand the importance of industrial pollution and its abatement
2. To study the underlying principles of industrial pollution control
3. To acquaint the students with case studies
4. Student should be able to design complete treatment system

Unit I : Industries & Environment

Industrial scenario in India - Industrial activity and Environment - Uses of Water by industry - Sources and types of industrial wastewater - Industrial wastewater and environmental impacts - Regulatory requirements for treatment of industrial wastewater - Industrial waste survey - Industrial wastewater generation rates, characterization and variables - Population equivalent - Toxicity of industrial effluents and Bioassay tests.

Unit II : Industrial Noise pollution

Sources of noise pollution, characterization of noise pollution prevention& control of noise pollution, Factories Act 1948 for regulatory aspects of noise pollution.

Unit III : Air Pollutant Abatement

Air pollutants scales of concentration, lapse rate and stability, plume behavior, dispersion of air pollutants, atmospheric dispersion equation and its solutions, Gaussian plume models.Air pollution control methods, Source correction methods, Design concepts for pollution abatement systems for particulates and gases. Such as gravity chambers, cyclone separators, filters, electrostatic precipitators, condensation, adsorption and absorption, thermal oxidation and biological processes.

Unit IV : Waste water treatment processes

Design concepts for primary treatment, grid chambers and primary sedimentation basins, selection of treatment process flow diagram, elements of conceptual process design, design of thickner, biological treatment Bacterial population dynamics, kinetics of biological growth and its applications to biological treatment, process design relationships and analysis, determination of kinetic coefficients, activated sludge process. Design, trickling filter design considerations, advanced treatment processes, Study of environment pollution from process industries and their abatement: Fertilizer, paper and pulp, inorganic acids, petroleum and petrochemicals, recovery of materials from process effluents.

Unit V : Solid waste and Hazardous waste management

xSources and classification, properties, public health aspects, Sanitary land fill design, Hazardous waste classification and rules, management strategies, Nuclear waste disposal Treatment methods – component separation, chemical and biological treatment, incineration, solidification and stabilization, and disposal methods, Latest Trends in solid waste management.

References

1. Rao C.S., "Environmental Pollution Control Engineering", 2nd edition
2. Mahajan S.P., "Pollution Control in Process Industries".
3. Nemerow N.L., "Liquid waste of industry- theories, Practices and Treatment", Addison Wesley, New York, 1971
4. Weber W.J., "Physico-Chemical Processes for water quality control", Wiley Interscience New York, 1969
5. Strauss W., "Industrial Gas Cleaning", Pergamon, London, 1975
6. Stern A.C., "Air pollution", Volumes I to VI, academic Press, New York, 1968
7. Peterson and Gross .E Jr., "Hand Book of Noise Measurement", 7th Edn, 2003.
8. Antony Milne, "Noise Pollution: Impact and Counter Measures", David & Charles PLC, 2009.

Course Outcomes: At the end of the course, the student will be able to:

1. Recognize the causes and effects of environmental pollution
2. Analyze the mechanism of proliferation of pollution
3. Develop methods for pollution abatement and waste minimization
4. Design treatment methods for gas, liquid and solid wastes
5. Nuclear waste disposal Treatment methods

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1			1		1			1				
CO2			1	1								
CO3		2			1			1				
CO4			1		2							
CO5			1	1				1				

CH15C **TRANSPORT IN POROUS MEDIA**

Instruction , hours/week : 3 Credits : 3 Assessment : 40 + 60

Objectives:

1. Introduce the physics and governing mechanisms controlling flow and transport processes in porous media.
2. Learning Liquid and solute transport in porous media.

Unit-I: Fundamentals: Mass, momentum and energy transport, Darcy and Non-Darcy equations, equilibrium and non-equilibrium conditions, species transport, radioactive decay.

Unit-II: Effective medium approximation: equivalent thermal conductivity, viscosity, dispersion.

Unit-III: Exact solutions: Flow over a flat plate, flow past a cylinder, boundary-layers, reservoir problems.

Unit-IV: Special topics: Field scale and stochastic modeling, Turbulent flow, compressible flow, multiphase flow, numerical techniques, hierarchical porous media, nano scale porous media, multiscale modeling.

Unit-V: Engineering applications: Groundwater, waste disposal, oil and gas recovery, regenerators ,energy storage systems. Experimental techniques: Flow visualization, quantitative methods, inverse parameter estimation.

References:

1. Principles of Heat Transfer in Porous Media, by M. Kaviany, Springer New York (1995).
2. Transport Phenomena in Porous Media, Volumes I-III, edited by D. R. Ingham and I. Pop, Elsevier, New York (1998-2005).
3. Dynamics of Fluids in Porous Media, J. Bear, Dover (1988).
4. Introduction to Modeling of Transport Phenomena in Porous Media, J. Bear and Y. Bachmat, Kluwer Academic Publishers, London (1990).
5. Enhanced Oil Recovery, L.W. Lake, Gulf Publishing Co. Texas (1989).
6. The Mathematics of Reservoir Simulation, R.E. Ewing, SIAM Philadelphia (1983).
7. Stochastic Methods for Flow in Porous Media: Coping with Uncertainties, Zhang, D., Academic Press, California (2002).
8. The Method of Volume Averaging, S. Whitaker, Springer, New York (1999).

Outcomes: At the end of this course, students are able to:

1. Students will understand the mechanisms involved in transport processes in porous media and will be able to work with the equations that govern the fate and transport of gas, water and solutes in porous media.

CH15C CHEMOINFORMATICS

Instruction, hours/week : 3 Credits : 3 Assessment : 40 + 60

Objectives

1. To give students a concept of Chemo-informatics related to chemical structure databases and database search methods
2. To understand the quantum methods and models involved in drug discovery and targeted drug delivery
3. To study the application of Chemical Libraries, Virtual Screening, Prediction of Pharmacological Properties

Unit I : Chemo-informatics

Introduction, scope and application, Basics of Chemo-informatics, Current Chemo-informatics resources for synthetic polymers, pigments. Primary, secondary and tertiary sources of chemical information, Databases: Chemical Structure Databases (PubChem, Binding database, Drugbank), Database search methods:chemical indexing, proximity searching, 2D and 3D structure and substructure searching. Drawing the Chemical Structure: 2D & 3D drawing tools (ACD Chemsketch) Structure optimization.

Unit II : Introduction to quantum methods

Combinatorial chemistry (library design, synthesis and deconvolution), spectroscopic methods and analytical techniques, Representation of Molecules and Chemical Reactions: Different types of Notations, SMILES Coding, Structure of Mol files and Sd files (Molecular converter, SMILES Translator).

Unit III : Analysis and use of chemical reaction information

Chemical property information, spectroscopic information, analytical chemistry information, chemical safety information, Drug Designing: Prediction of Properties of Compounds, QSAR Data Analysis, Structure-Activity Relationships, Electronic properties, Lead Identification, Molecular Descriptor Analysis.

Unit IV : Target Identification

Molecular Modeling and Structure Elucidation: Homology Modelling (Modeller 9v7, PROCHECK), Visualization and validation of the Molecule (Rasmol, Pymol Discovery studio), Applications of Chemoinformatics in Drug Research - Chemical Libraries, Virtual Screening, Prediction of Pharmacological Properties.

Unit V : Drug Discovery

Structure based drug designing, Docking Studies (Target Selection, Active site analysis, Ligand preparation and conformational analysis, Rigid and flexible docking, Structure based design of lead compounds, Library docking), Pharmacophore - Based Drug Design, Pharmacophore Modeling (Identification of pharmacophore features, Building 2D/3D pharmacophore hypothesis), Toxicity Analysis-Pharmacological Properties (Absorption,

Distribution and Toxicity), Global Properties (Oral Bioavailability and Drug-Likeness) (ADME, OSIRIS, and MOLINSPIRATION)

References

1. Bajorath J (2004), "Chemoinformatics: Concepts, Methods and Tools for Drug Discovery" Humana Press

2. Leach A, Gillet V, "An Introduction to Chemoinformatics" Revised edition, Springer

3. Gasteiger J. Engel T. "A textbook of Chemoinformatics" Wiley- VCH GmbH & Co. KGaA

4. Bunin B. Siesel B. Guillermo M. "Chemoinformatics: Theory, Practice & Products", Springer

5. Lavine B. (2005), "Chemometrics and Chemoinformatics", American Chemical Society

6. Casteiger J. and Engel T (2003) "Chemoinformatics" Wiley-VCH

7. Bunin Barry A. Siesel Brian, Morales Guillermo,Bajorath Jürgen. Chemoinformatics: Theory, Practice, & Products Publisher:New York, Springer. 2006.

8. Leach Andrew R., Valerie J. Gillet, "An introduction to Chemoinformatics", Publisher: Kluwer academic, 2003. ISBN: 1402013477

9. Gasteiger Johann, Handbook of Chemoinformatics: From Data to Knowledge (4 Volumes),

   2003. Publisher: Wiley-VCH.

Course Outcomes: At the end of the course, the student will be able to:

1. The course will introduce the students preparing for professional work in chemistry must learn how to retrieve specific information from the enormous and rapidly expanding chemical literature.

2. The course will provide a broad overview of the computer technology to chemistry in all of its manifestations.

3. The course will expose the student to current and relevant applications in QSAR and Drug Design.

CH15C ADVANCED CONTROL SYSTEMS

Instruction : 3 hr/week Credits : 3 Evaluation : 40 + 60

Course Educational Objectives ; Students will have to learn the following

1) Learn the Concepts of Advanced Control Strategies
2) Understand the Multi Input and Multi Output controlling
3) Understand the Purpose of Digital Data Acquisition and Control
4) Develop Discrete Time Models & Their Dynamic Response
5) Design the Digital Controllers

Unit I :

Feed Forward and Ratio Control – Introduction, Feed forward controller design based on steady state and dynamic models, tuning and configuration of feed forward control

Advanced Control Strategies – Cascade control, time delay compensation and inferential control, selective and override systems, adaptive control, statistical process control

Unit II :

Control of Multi Input, Multi-Output Systems – Process interactions and control loop interactions, pairing of controlled and manipulated variables, strategy for reducing interactions, decoupling, multivariable control techniques

Supervisory Control – Basic requirements, applications, formulation and solution of optimization problems, unconstrained and constrained optimization

Unit III :

Digital Computer Control – Digital control systems in process control, distributed instrumentation and control systems, general purpose digital data acquisition, digital control hardware and software, table driven PID controller, Programmable logic controllers and batch process control

Sampling and Filtering of Continuous Measurements – Sampling and signal reconstruction, selection of sampling period, signal processing and data filtering, comparison of analog and digital filters, effect of filter selection on control system performance

Unit IV :

Development of Discrete Time Models – Finite difference models, exact discretization for linear systems, higher order systems, fitting discrete time equations to process data

Dynamic Response of Discrete –Time Systems – The z-Transform, inversion, pulse transfer function, relating pulse transfer functions to difference equations, effect of pole and zero locations, conversion between laplace and z- transforms

Unit V :

Analysis of Sampled – Data Control Systems – Open loop block diagram analysis, development of closed loop transfer functions, stability of sampled data control systems

Design of Digital Controllers – Digital PID controller, selection of controller parameters, direct synthesis methods, digital feed forward control, combined load estimation and time delay compensation

Text Books:

1. Process Dynamics and Control – D.E.Seborg, T.F.Edgar and D.A.Mellichamp, John Wiley &
Sons
2. Chemical Process control – An Introduction to Theory and Practice - George Stephanopoulos,
Prentice hall 1990.

Course Objectives : Students will be able to understand and analyze

1) Feed Forward, Ratio Controls and Advanced Controllers
2) Control Loop Interactions & Optimization
3) Digital Computer Control, selection of sampling period, comparison of analog and digital filters
4) Finite Difference Models, Z-Transforms, Pulse Transfer Functions
5) Samples and Data Control Systems

CH21C MEMBRANE SEPARATIONS

Instruction , hours/week : 3 Credits : 3 Assessment : 40 + 60

Course Educational Objectives ; Students will have to learn the following

1) Learn the Properties of Membrane and Types of Membrane
2) Learn the Types of Filtrations used
3) Design Reverse Osmosis Module
4) Learn Gas Separation and Pervaporation
5) Understand different Membrane Processes

UNIT I :

OverView of Membrane Separations

Membrane Types, Materials, Preparation and Characterization - Types of Synthetic Membranes – Membrane Modules – Typical Flow patterns – Membrane materials – Pore Characteristics – Membrane Manufacture – Measurement of Pore size and Solute rejection Properties – surface Properties measurement and interpretation

UNIT II :

Nano Filtration – principles – nano-filtration membranes – Mass Transfer – Process Limitations – Industrial application

Ultrafiltration - Basic Principles – Membranes – Configuration – Types of Devices – Factors affecting performance – Flux – Models for Solvent Flux – Fouling and Flux decline – Methods to reduce Concentration Polarization – Energy Considerations – Micellar enhanced UF – Affinity UF – Applications

Microfiltration – Basic Principles – Membranes – Transport Mechanism – retention characteristics – Flow Characteristics – Membrane Plugging and Throughput – Fouling – energy Considerations – Applications

UNIT III :

Reverse Osmosis - Concepts – Phenomenon of RO – Models for RO transport – Design and Operating parameters – Concentration Polarization – Membrane plugging – Equivalent work requirement – Design of an RO module – RO of non-aqueous systems – Osmotic pinch effect – Forward osmosis – Applications

Dialysis – Principles – Dialysis systems – Membranes – Mass transfer – Applications – Diffusion dialysis

UNIT IV :

Gas Separation - Basic Principles – Membranes – Membrane Modules – Fundamental Mechanisms of Gas Transport - Factors affecting Gas Permeation – Complete Mixing Model – Cross and Countercurrent models – Applications

Pervaporation - Basic Principles – Advantages – Membrane characteristics – Thermodynamic Considerations – Mass transfer – Thermodynamic Considerations – Design of a Module – Concentration Polarization – factors affecting pervaporation – Temperature drop at the interface – Applications

UNIT V :

Ion Exchange Membrane Process - Basic Principles – Ion exchange Membranes – Energy requirement, Efficiency- Concentration Polarization and limiting current density – Other operating parameters – applications

Liquid Membranes - Types of liquid membranes – Mechanism of Mass transfer – Applications

Other Membrane Processes – Membrane contactor and applications – Membrane distillation – Membrane reactors – PEM Hydrogen Fuel Cell

Text Book

1. Membrane Separation Processes – Kaushik nath – Prentice Hall, 2008

References

1. Reverse Osmosis and Synthetic Membranes Theory, Technology and Engineering, Sourirajan,S National Research Council, Canada.
2. Reverse Osmosis/ Ultrafiltration Process Principles, Sourirajan,S. and Matsuura, T., National Research Council, Canada. Separation Processes, Elsevier Scientific Publication.
3. Industrial Membrane Separation Technology, Scott,K., and Hughes, R. (Eds.), Blackie Academic & Professional London.
4. Separation Processes, King, C.J, Tata McGraw Hill, New Delhi.
5. Membrane Processes, Rautenbatch, R., and Albrecht, R John Wiley & Sons, New York.
6. Membrane Separation Processes, Baum,B., Halley, W. and White, R.A, Elsevier Scientific Publication

Course Objectives : Students gain

1) Knowledge on Preparation and Characterization of Materials and Types of Membrane
2) Knowledge on Nano-Filtration, Ultra-Filtration and Micro-Filtration
3) Knowledge on Designing Reverse Osmosis and Dialysis
4) Concepts of Gas Separation and Pervaporation and Design of Pervaporation Module
5) Knowledge on Ion Exchange Membrane Process, Liquid Membranes and Other Membrane Processes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		1	1	1				1	1			
CO2			1					2	1			
CO3		1	1					1	1			
CO4			1	1				2	1			
CO5		2		1					1			

CH22C **OPTIMIZATION THEORY & PRACTICE**

Instruction , hours/week : 3 Credits : 3 Assessment : 40 + 60

Course Educational Objectives :

1) To learn problem formulation and basic concepts of optimization.
2) To study the numerical methods to solve single variable un-constrained problems
3) To understand and apply numerical methods to solve un-constrained multi-variable problems
4) To learn linear& non-linear programming methods
5) To know the applications of optimization through different examples

Unit-I: Introduction

Basic concepts of optimization, applications of optimization, general procedure for solving optimization problem, formulation of the objective function, fitting models to data, classification of functions.

Unit-II: Single Variable unconstrained optimization methods

Direct search methods-Interval halving method, Fibonacci method, Golden section method;
Direct root methods-Newton method and Quasi Newton method;
Polynomial approximation methods - Quadratic interpolation and cubic interpolation.

Unit-III: Optimization of unconstrained multivariable functions

Direct search methods-random search, grid search, uni-variate search and pattern search methods. ; Indirect search methods - steepest descent, conjugate gradient methods, Newton's method and secant method.

Unit-IV: Linear and non-linear programming

Linear programming: Basic concepts in linear programming, Standard LP from, Graphical solution and Simplex method.

Non-linear programming: Lagrange multiplier method, Quadratic programming, Penalty function and augmented Lagrangian methods.

Unit –V: Applications of optimization

Optimizing recovery of waste heat, optimal design and operation of a conventional staged-distillation column, optimal pipe diameter, optimal residence time for maximum yield in chemostat and optimization of a thermal cracker using linear programming.

Text Book:

1.Edgar, T. F., Himmelblau, D. M. and Ladson, L. S., "Optimization of Chemical Processes", 2nd Ed., McGraw Hill, New York.

Reference Books :

1. Diwaker, U. W. “Introduction to Applied Optimization”, Kluwer.
2. Joshi, M. C. and Moudgalya, K. M., “Optimization, Theory and Practice”, Narosa, New Delhi, 2004.
3. Rao, S. S., Engineering Optimization: Theory and Practice, New Age Publishers.

Course Outcomes: Student will be able to

1) formulate and analyse the optimization of the given physical situation.
2) Apply different methods of optimization and to suggest a technique for specific problem
3) Understand the difference between constrained and unconstrained optimization
4) Understand the importance of linear programming problems
5) Realize the importance of optimization by understanding different examples

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1		1	1	1				1	1			
CO2		2	1	1				2	1			
CO3		1	1	1		2	1	1	1			
CO4		2	1	1				2	1			
CO5		2	2	1				1	1			

CH25L **STEADY STATE SIMULATION LAB II Semester**

Instruction , hours/week : 3 Assessment : 40 + 60

To introduce students to use of software packages for simulation and also analyzing flow sheets

1. Introduction of Software packages.
2. Setting up models for simulation.
3. Flow sheeting concepts.
4. Steady state simulation for generation of VLE data.
5. Steady state simulation for conversion calculation for single and multiple reactions
6. Steady state simulation for heat and cooling duty of heat exchangers.
7. Simulation of flash column.

CH26L **ADVANCED INSTRUMENTATION LAB**

Instruction , hours/week : 3 Assessment : 40 + 60

To introduce students to use of new Analytical Instruments for analysis like UV Spectro Photo meter, HPLC, Atomic Adsorption Spectro Photometer etc.

INDUSTRIAL SAFETY

Unit-I: Industrial safety: Accident, causes, types, results and control, mechanical and electricalhazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering,Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reductionmethods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV: Fault tracing: Fault tracing-concept and importance, decision tree concept, need andapplications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing,cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

CH23C MODERN CONCEPTS IN CATALYSIS AND SURFACE PHENOMENON

Instruction , hours/week : 3 Credits : 3 Assessment : 40 + 60

Objectives

1. To give the students insight into advances in catalytic reaction engineering
2. To understand the mechanisms involved in catalytic reactions
3. To study the catalyst characterization techniques
4. To study the advanced industrial applications in catalysis
5. To understand the principles behind catalyst deactivation and study their models

Unit I : Introduction to Catalysis

Definition of Catalytic activity, Magnitude of Turnover Frequencies and Active Site Concentrations, Evolution of Important Concepts and Techniques in Heterogeneous Catalysis, Classification of Catalysts – Homogeneous, Heterogeneous, Biocatalysts, Dual Functional Catalysts, Enzymes, Solid Catalysts, Powder Catalysts, Pellets, Composition, Active Ingredients, Supportive materials, Catalysts Activation, Catalyst Deactivation.

Unit II : Adsorption in Catalysis

Adsorption and its importance in Catalysis, Adsorption and potential energy curves, Surface Reconstruction, Adsorption Isotherms and Isobars, Dynamical Considerations, Types of Adsorption Isotherms and their Derivation from Kinetic Principles, Mobility at Surfaces, Kinetics of surface Reactions, Photochemistry on oxide and metallic surfaces, Characterization of the adsorbed molecules

Unit III : Catalyst Characterization

Catalyst Characterization Methods – Their Working Principle and Applications – XRF, XRD, IR Spectroscopy, XPS, UPS, ESR, NMR; Infrared, Raman, NMR, Mossbauer and X-Ray Absorption spectroscopy, Surface Acidity and Toxicity, Activity, Life time, Bulk density, Thermal stability Crystal Defects, Peroviskites, Spinels, Clays, Pillared Clays, Zeolites

Unit IV : Significance of Pore Structure and Surface Area

Importance of Surface Area and Pore Structure, Experimental Methods for Estimating Surface Area– Volumetric, Gravimetric, Dynamic Methods, Experimental Methods for Estimating Pore Volume and Diameter – Gas Adsorption and Mercury Porosimeter Method, Models of the Pore Structure – Hysteresis Loops, Geometric Models, Wheeler's Model, Dusty Gas Model, Random Pore Model, Diffusion in Porous Catalysts – Effective Diffusivity, Knudsen Diffusion, Effect of Intraparticle Diffusion, Non-isothermal Reactions in Pores, Diffusion Control.

Unit V : Industrial applications– Case Studies

Industrial processes involving heterogeneous solid catalyst: Synthesis of Methanol, Fiscer-Tropsch Catalysis, Synthesis of Ammonia, Automobile Exhaust Catalysts and Catalyst Monolith, Photocatalytic Breakdown of Water and the Harnessing of Solar Energy.

Contribution of homogeneous catalytic process in chemical industry:Oxidations of Alkenes such as production of acetaldehyde, propylene oxide etc., Polymerization such as production of polyethylene, polypropylene or polyester production

References

1. Emmett, P.H. - “Catalysis Vol. I and II, Reinhold Corp.", New York, 1954
2. Smith, J.M. - “Chemical Engineering Kinetics ", McGraw Hill, 1971
3. Thomas and Thomas - “Introduction to Heterogeneous Catalysts ", Academic Press, London 1967
4. Piet W.N.M. van Leeuwen, Homogeneous catalysis: Understanding the Art, Springer, 2004
5. Piet W.N.M. van Leeuwen, and John C. Chadwick, Homogeneous catalysis: Activity-stability –deactivation, Wiley, VCH, 2011.

Course Outcomes: At the end of the course, the student will be able to:

1. To understand the concepts of homogenous and heterogeneous catalysis, with specific examples.
2. To study reaction mechanisms and kinetics of homogenous and heterogeneous catalytic reactions.
3. To familiarize with the characterization of catalysts
4. To understand the application and mechanisms of several types of catalysts in chemical industry.

CH22C ADVANCED DOWNSTREAM PROCESSING

Instruction , hours/week : 3 Credits : 3 Assessment : 40 + 60

Objectives

1. To understand the unit processes involved in downstream processing.
2. To study advanced treatment methods.
3. To study the energy conservation in different separation processes
4. To understand the underlying design principles

Unit I : Introduction]

Introduction to Downstream processes theory, applications in chemical separation for Gas-Liquid system, Gas-Solid system. Super critical fluids extraction in food, pharmaceutical, environmental and petroleum applications, water treatment, desalination, Bio separation, dialysis, industrial dialysis.

Unit II : Downstream Processes in Petrochemical Industry

Cryogenic distillation for refinery, petrochemical off gases, natural gases, gas recovery-Olefin, Helium, Nitrogen, Desulfurization - coal, flue gases

Unit III :Advanced Distillation Processes

Azeotropic & extractive distillation - residue curve maps, homogeneous azeotropic distillation, pressure swing distillation, Column sequences, heterogeneous azeotropic distillation.

Unit IV : Energy conservation in separation processes

Energy balance, molecular sieves - zeolights, adsorption, catalytic properties, manufacturing processes, hydrogel process, application, New trends.

Unit IV : Non-Ideal Mixtures and Ion Exchange

Separations process synthesis for nonazeotropic mixtures, non ideal liquid mixtures, separation synthesis algorithm, Ion exchange - manufacture of resins, physical & chemical properties, capacity, selectivity, application, regeneration, equipment, catalysis use.

References

1. Perry's "Chemical Engg. Handbook": McGraw Hill Pub.
2. Douglas J.M., "Conceptual Design of Chemical Processes", McGraw Hill
3. Liu Y.A., "Recent Developments in Chemical Process & Plant Design", John Wiley & Sons Inc.
4. Timmerhaus K.D., "Cryogenic Process Engg.", Plenum Press
5. Othmer Kirk "Encyclopedia of Separation Technology, Vol I & II", Wiley Interscience

Course Outcomes: At the end of the course, the student will be able to:

1. To learn effective strategies of downstream processing in chemical industry.
2. Understand the role of downstream processing.
3. Analyze reactors, upstream and downstream processes in production

CH23C **PROCESS SYNTHESIS & ANALYSIS**

Instruction , hours/week : 3 Credits : 3 Assessment : 40 + 60

Course Objectives:

1) To familiarize the students about various economic aspects of chemical processes
2) To Learn basics of Cost estimation and to understand the time value of money
3) To Learn the importance of Cash flow diagrams and Break-even analysis.
4) To Study depreciation methods and methods of estimation of profitability of an industry
5) To Study about heat exchanger networks.

UNIT-I :

Nature of Process Synthesis & Analysis : Creative aspects – A hierarchial approach

Enginering Economics : Cost Information – Estimation of Capital and Operating Costs – Total Capital Investment- Total Product Cost - Time Value of Money – Measures of Process Profitability – Simplifying the Economic Analysis for Conceptual Design

UNIT II :

Economic Decision Making : Solvent Recovery System – Problem Definition & General Considerations – Design of a Gas Absorber – Equipment Design Consideration – Rules of Thumb

Input Information & Batch- Continuous: Input Information – Level 1 Decision – Batch Vs. Continuous

UNIT III :

Input-Output Structure of the Flow Sheet : Decisions for the I/O structure – Design Variables – Over all Material Balances – Stream Costs – Process Alternatives

Recycle Structure of the Flow Sheet : Decisions determining the recycle Structure – Recycle Material balances – reactor Heat Effects – Equilibrium Limitations – Compress Design & Costs – Reactor Design – recycle Economic Evaluation

Unit IV :

Heat Exchanger Networks – Minimum Heating & Cooling Requirements – Minimum Number of Exchangers – Area Estimates – Design of Minimum Energy Heat Exchanger Networks – Loops and Paths – Reducing the Number of Exchanger – Stream Splitting – Heat and Power Integration – Heat Distillation – HAD Process

UNIT V :

Separation System : General Structure – Vapor Recovery System – Liquid Separation System – Azeotropic Systems – Rigorous Material Balances

Cost Diagrams and Quick Screening of Process Alternatives - Cost Diagrams for simple and complex process – Quick Screening of Process Alternatives – HAD Process

Text Book :

1. Conceptual Design of Chemical Processes, Douglas, J.M., McGraw Hill,

Reference Books :

1. Chemical Process Design, Robin Smith, McGraw Hill,
2. Chemical Process Design, Dimian A.C, & Bidea,C.S., Wiley – VCH,2008
3. Chemical Process Synthesis & Engineering Design, Kumar,A, Tata McGraw Hill,1982
4. Systematic Methods of Chemical Process Design, Bieglar, L.T., Grossman, E.I and Westerberg, A.W. Prentice Hall Inc.
5. Product and Process Design Principles, Seider, W.D., Seider,J.D & Lewin, D.R. Wiley,2005

Course Outcomes: Student will be able to

1) understand the concepts of Engineering economics
2) Able to estimate various costs involved in a process industry and evaluate the tax burden of an establishment
3) Able to estimate profitability of a company
4) Understand the heat exchanger networks and their importance in industry
5) Compute break even period for an investment and rate of return

CH23C **MICRO AND NANO FLUIDICS**

Instruction , hours/week : 3 Credits : 3 Assessment : 40 + 60

Objectives:

1. To introduce to the students, the various opportunities in the emerging field of micro and nano fluids.
2. To the make students familiar with the important concepts applicable to small micro and nano fluidic devices, their fabrication, characterization and application
3. To get familiarize with the new concepts of real-time nano manipulation &

Unit-1: Introduction: Fundamentals of kinetic theory-molecular models, micro and macroscopic properties, binary collisions, distribution functions, Boltzmann equation and Maxwellian distribution functions-Wall slip effects and accommodation coefficients, flow and heat transfer analysis of micro scale Couette flows, Pressure driven gas micro-flows with wall slip effects, heat transfer in micro-Poiseuille flows, effects of compressibility. Pressure Driven Liquid Micro flow: apparent slip effects, physics of near-wall micro scale liquid flows, capillary flows, electro-kinetically driven liquid micro - flows and electric double layer (EDL) effects, concepts of electro osmosis, electrophoresis and dielectro-phoresis.

Unit- 2: Laminar flow: Hagen-Poiseullie eqn, basic fluid ideas, Special considerations of flow insmall channels, mixing, microvalves & micropumps, Approaches toward combining living cells, microfluidics and 'the body' on a chip, Chemotaxis, cell motility. Case Studies in Microfluidic Devices. Ionic transport: Polymer transport – microtubule transport in nanotuble channels driven by Electric Fields and by Kinesin Biomolecular Motors - Electrophoresis of individual nanotubules in microfluidic channels.

Unit-3: Fabrication techniques for Nanofluidic channels – Bio molecules separation using Nanochannels - Biomolecules Concentration using Nano channels – Confinement of Bio molecules using Nano channels. Hydrodynamics: Particle moving in flow fields – Potential Functions in Low Renoyld's Number Flow – Arrays of Obstacles and how particles Move in them: Puzzles and Paradoxes in Low Re Flow.

Unit-4: Micro fluidics and Lab-on-a-chip: Microfluidic Devices - Microchannels, Micro filters, Microvalves, Micropumps, Microneedles, Microreserviors, Micro-reaction chambers. Concepts and Advantages of Microfluidic Devices - Fluidic Transport - Stacking and Scaling – Materials for The Manufacture (Silicon, Glass, Polymers) - Fluidic Structures - Fabrication Methods - Surface Modifications - Spotting - Detection Mechanisms. Microcontact printing of ProteinsStrategies-printing types- methods and characterization-Cell nanostructure interactions-networks for neuronal cells. Applications in Automatic DNA sequencing, DNA and Protein microarrays.

Unit-5: BioMEMS (Micro-Electro-Mechanical Systems): Introduction and Overview, BiosignalTransduction Mechanisms: Electromagnetic Transducers Mechanical Transducers, Chemical Transducers, Optical Transducers – Sensing and Actuating mechanisms (for all types). Case Studies in Biomagnetic Sensors, Applications of optical and chemical transducers. Ultimate Limits of Fabrication and Measurement, Recent Developments in BioMEMS and BioNEMS - An alternative approach to traditional surgery, Specific targeting of tumors and other organs for drug delivery, Micro-visualization and manipulation,

Implantation of microsensors, microactuators and other components of a larger implanted device or external system (synthetic organs).

Text Books

1. Joshua Edel "Nanofluidics" RCS publishing, 2009.

2. Patric Tabeling "Introduction to Microfluids" Oxford U. Press, New York 2005.
3. K. Sarit "Nano Fluids; Science and Technology", RCS Publishing, 2007.

References

1. M. Madou, Fundamentals of Microfabrication, CRC Press, 1997

2. G. Kovacs, Micromachined Transducers, McGraw-Hill, 1998

3. Steven S Saliterman, Fundamentals of BioMEMS and Medical Microdevices, 2006

Outcomes: At the end of this course, students are able to:

1. Introduce students to the physical principles to analyze fluid flow in micro and nano-size devices. It unifies the thermal sciences with electrostatics, electrokinetics, colloid science; electrochemistry; and molecular biology.

CH24C PHASE TRANSITIONS IN PROCESS EQUIPMENT

Instruction , hours/week : 3 Credits : 3 Assessment : 40 + 60

Objectives:

1. Basic laws in thermodynamics.
2. Basic statistical concepts and methods: heat, work, energy, temperature and the kinetic theory of matter; entropy, ensemble, partition function, etc
3. Learning phase transition catalysis
4. Have a good grasp of the basic thermodynamic interactions and process: adiabatic, isothermal, etc

Unit-I: Thermodynamic aspects of phase transitions: Concept of phase, First-order phase transition,conditions for phase coexistence lines, free energy barrier of nucleation, and crystal-melt interfacial free energy, Ehrenfest classification of phase transitions, Van der Waals equation of state, Critical point

Unit-II: Single phase and multiphase catalytic reactions, Acid--base catalysis, Transition metal catalysis, Phase transfer catalysis, Micellar catalysis, Microemulsion catalysis, Electron transfer catalysis, Heteropoly acid catalysis, Homogeneous polymer catalysis, Heterogenisation of homogeneous catalysts.

Unit-III: Applications to Multi-phase Systems Stability conditions for a homogeneous system, equilibrium between phases, phase transformations, general relations for a system with several components, general conditions for chemical equilibrium, chemical equilibrium between ideal gases, and the equilibrium constants in terms of partition functions.

Unit -IV: Phase diagrams and transformations Phase rule- single and binary phase diagrams, lever rule, micro structural changes during cooling, Al_2O_3, Cr_2O_3, Pb-Sn, Ag-Pt and Fe-Fe_3C Systems phase diagrams, phase transformations, corrosion- theories of corrosion, control and prevention of corrosion

UNIT-V: Energy balance - heat capacity and calculation of enthalpy changes, Enthalpy changes for phase transitions, evaporation, clausius - clapeyron equation,

References:

1. Hegedus, L.S., Transition Metals in the Synthesis of Complex Organic Molecules, University Science Book (2010) 3rd ed.
2. Raghavan V., Material Science and Engineering Prentice Hall of India, 1996
3. David.M.Himmelblau, “Basic principles and calculations in chemical engineering”, Prentice Hall of India Ltd., 6th Edition, 1998.
4. A.Hougen, K.M. Watson and K.A.Ragatz, “Chemical Process Principles”, Vol 1, John Wiley, 1960.

Outcomes: At the end of this course, students are able to:

1. The student is expected to obtain considerable insight into various types of phase transitions, and how these can be described theoretically in different ways

2. Predict relationships between physical quantities using the laws and methods of thermodynamics.

3. Find probabilities and thermal quantities (free energy, entropy, etc) given the energy eigen values of a system.
4. The student is expected to obtain considerable insight into various types of phase transitions, and how these can be described theoretically in different ways

5. Predict relationships between physical quantities using the laws and methods of thermodynamics.

6. Find probabilities and thermal quantities (free energy, entropy, etc) given the energy eigen values of a system.

CH24C **PROCESS INTENSIFICATION**

Instruction , hours/week : 3 Credits : 3 Assessment : 40 + 60

Objectives:

1. Understand the concept of Process Intensification.
2. Know the limitations of intensification of the chemical processes.
3. Apply the techniques of intensification to a range of chemical processes.
4. Develop various process equipment used for intensifying the processes.
5. Infer alternative solutions keeping in view point, the environmental protection, economic viability and social acceptance.

Unit-I: Introduction: Techniques of Process Intensification (PI) Applications, The philosophy andopportunities of Process Intensification, Main benefits from process intensification, ProcessIntensifying Equipment, Process intensification toolbox, Techniques for PI application.

Unit-II: Process Intensification through micro reaction technology: Effect of miniaturization on unitoperations and reactions, Implementation of Microreaction Technology, From basic Properties To Technical Design Rules, Inherent Process Restrictions in Miniaturized Devices and Their Potential Solutions, Microfabrication of Reaction and unit operation Devices - Wet and Dry Etching Processes.

Unit-III: Scales of mixing, Flow patterns in reactors, Mixing in stirred tanks: Scale up of mixing, Heat transfer. Mixing in intensified equipment, Chemical Processing in High-Gravity Fields Atomizer Ultrasound Atomization, Nebulizers, High intensity inline MIXERS reactors Static mixers, Ejectors, Tee mixers, Impinging jets, Rotor stator mixers, Design Principles of static Mixers Applications of static mixers, Higee reactors.

Unit-IV: Combined chemical reactor heat exchangers and reactor separators: Principles of operation;Applications, Reactive absorption, Reactive distillation, Applications of RD Processes, Fundamentals of Process Modelling, Reactive Extraction Case Studies: Absorption of NOx Coke Gas Purification. Compact heat exchangers: Classification of compact heat exchangers, Plate heat exchangers, Spiral heat exchangers, Flow pattern, Heat transfer and pressure drop, Flat tube-and-fin heat exchangers, Microchannel heat exchangers, Phase-change heat transfer, Selection of heat exchanger technology, Feed/effluent heat exchangers, Integrated heat exchangers in separation processes, Design of compact heat exchanger - example.

Unit-V: Enhanced fields: Energy based intensifications, Sono-chemistry, Basics of cavitation,Cavitation Reactors, Flow over a rotating surface, Hydrodynamic cavitation applications, Cavitation reactor design, Nusselt-flow model and mass transfer, The Rotating Electrolytic Cell, Microwaves, Electrostatic fields, Sonocrystallization, Reactive separations, Superctrical fluids

References:

1. Stankiewicz, A. and Moulijn, (Eds.), Reengineering the Chemical Process Plants, Process Intensification, Marcel Dekker, 2003.
2. Reay D., Ramshaw C., Harvey A., Process Intensification, Butterworth Heinemann, 2008.
3. Kamelia Boodhoo (Editor), Adam Harvey (Editor),Process Intensification Technologies for Green Chemistry: Engineering Solutions for Sustainable Chemical Processing, Wiley, 2013.
4. Segovia-Hernández, Juan Gabriel, Bonilla-Petriciolet, Adrián (Eds.)Process Intensification in Chemical Engineering Design Optimization and Control, Springer, 2016.
5. Reay, Ramshaw, Harvey, Process Intensification, Engineering for Efficiency, Sustainability and Flexibility, Butterworth-Heinemann, 2013.

Outcomes: At the end of this course, students are able to:

1. Assess the values and limitations of process intensification, cleaner technologies and waste minimization options.
2. Measure and monitor the usage of raw materials and wastes generating from production and frame the strategies for reduction, reuse and recycle.
3. Obtain alternative solutions ensuring a more sustainable future based on environmental protection, economic viability and social acceptance.
4. Analyze data, observe trends and relate this to other variables.
5. Plan for research in new energy systems, materials and process intensification.

CH24C MICRO FLOW CHEMISTRY AND PROCESS TECHNOLOGY

Instruction , hours/week : 3 Credits : 3 Assessment : 40 + 60

Objectives:

1. Introduce the students to micro flow chemistry and process technology.
2. Learning Micromixers, Mixing Principles.
3. Learning micro reactor based chemicals production

Unit-I: State of the Art of Micro reaction Technology, Structural Hierarchy of Micro reactors, Functional Classification of Micro reactors, Fundamental Advantages of Micro reactors, Advantages of Micro reactors Due to Decrease of Physical Size, Advantages of Micro reactors Due to Increase of Number of Units, Potential Benefits of Micro reactors

Unit-II: Modern Micro fabrication Techniques for Micro reactors, Evaluation of Suitability of a Technique, Anisotropic Wet Etching of Silicon, Dry Etching of Silicon, LIGA Process, Injection Molding, Wet Chemical Etching of Glass, Advanced Mechanical Techniques

Unit-III: Micro mixers, Mixing Principles and Classes of Macroscopic Mixing Equipment, Mixing Principles and Classes of Miniaturized Mixers, Mixing Tee-Type Configuration

Unit-IV: Microsystems for Gas Phase Reactions, Catalyst Supply for Micro reactors , Types of Gas Phase Micro reactors, Micro channel Catalyst Structures, H_2/O_2 Reaction, Selective Partial Hydrogenation of Benzene, Selective Oxidation of 1-Butene to Maleic Anhydride, Selective Oxidation of Ethylene to Ethylene Oxide, Oxidative Dehydrogenation of Alcohols, Synthesis of Methyl Isocyanate and Various Other Hazardous Gases, Synthesis of Ethylene Oxide, Oxidation of Ammonia

Unit-V: Microsystems for Energy Generation, Micro devices for Vaporization of Liquid Fuels, Micro devices for Conversion of Gaseous Fuels to Syngas by Means of Partial Oxidations, Hydrogen Generation by Partial Oxidations, Micro devices for Conversion of Gaseous Fuels to Syngas by Means of Steam Reforming

References:

1. Wolfgang Ehrfeld, Volker Hessel, Holger Löwe MicroreactorsNew Technology for Modern Chemistry © WILEY-VCH Verlag GmbH, D-69469 Weinheim (Federal Republic of Germany), 2000.
2. S.V. Luis and E. Garcia-Verdugo, Chemical Reactions and Processes under Flow Conditions, University Jaume I/CSIC, Castello´n, Spain, The Royal Society of Chemistry 2010
3. Madhvanand N. Kashid, Albert Renken,and Lioubov Kiwi-Minsker, Microstructured Devices for Chemical Processing, Wiley-VCH Verlag GmbH & Co. KGaA, Boschstr ©2015 12, 69469 Weinheim, German.
4. Hessel, V., Renken, A., Schouten, J.C., Yoshida, Micro Process Engineering" A Comprehensive Handbook 2009, ISBN 978-3-527-31550-5.

Outcomes: At the end of this course, students are able to:

1. Students will understand the role of micro flow chemistry and process technology in chemical engineering.
2. The student is expected to obtain considerable insight into various types of micro reactors.

CH24C PROCESS PLANT DESIGN & FLOW SHEETING TOOLS

Instruction , hours/week : 3 Credits : 3 Assessment : 40 + 60

Objectives:

1. Understanding of the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the specific discipline.
2. Application of established engineering methods to complex engineering problem solving.
3. Application of systematic engineering synthesis and design processes.

Unit-I: Introduction: Basic concepts: General design considerations, Process design development, Layout of plant items, Flow sheets and PI diagrams, Economic aspects and Optimum design, Practical considerations in design and engineering ethics, Degrees of freedom analysis in interconnected systems, Network analysis, PERT/CPM, Direct and Indirect costs, Optimum scheduling and crashing of activities.

Unit-II: Hierarchy of chemical process design; Nature of process synthesis and analysis; Developing a conceptual design and flow sheet synthesis. Synthesis of reaction-separation systems; Distillation sequencing; Energy targets. Heat integration of reactors, distillation columns, evaporators and driers; Process change for improved heat integration. Heat and mass exchange networks and network design.

Unit-III: Flow-sheeting: Synthesis of flow sheet: Propositional logic and semantic equations, Deduction theorem, Algorithmic flow sheet generation using P-graph theory, Sequencing of operating units, Feasibility and optimization of flow sheet using various algorithms viz, Solution Structure Generation (SSG), Maximal Structure Generation (MSG), Simplex, Branch-and-bound etc.

Unit-IV: Analysis of Cost estimation: Factors affecting Investment and production costs, Estimation of capital investment and total product costs, Interest, Time value of money, Taxes and Fixed charges, Salvage value, Methods of calculating depreciation, Profitability, Alternative investments and replacements.

Unit- V: Optimum Design and Design Strategy: Break-even analysis, Optimum production rates in plant operation, Optimum batch cycle time applied to evaporator and filter press, Economic pipe diameter, Optimum insulation thickness, Optimum cooling water flow rate and optimum distillation reflux ratio.

References:

1. Peters, M.A. and Timmerhaus, K.D., Plant Design and Economics for Chemical Engineers, McGraw Hill (2003).
2. Anil Kumar, Chemical Process Synthesis and Engineering Design, Tata McGraw Hill (1982).

3. Ulrich, G.D., A Guide to Chemical Engineering Process Design and Economics, John Wiley & Sons (1984).

4. Perry, R.H. and Green, D., Chemical Engineer's Handbook, McGraw-Hill (1997).

Outcomes: At the end of this course, students are able to:

1. Analyze, synthesize and design processes for manufacturing products commercially
2. Integrate and apply techniques and knowledge acquired in other courses such as thermodynamics, heat and mass transfer, fluid mechanics, instrumentation and control to design heat exchangers, plate and packed columns and engineering flow diagrams
3. Use commercial flow sheeting software to simulate processes and design process equipment
4. Recognize economic, construction, safety, operability and other design constraints
5. Estimate fixed and working capitals and operating costs for process plants

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING:

TIRUPATI-517502

R-23– Scheme of Instructions effective from the academic year 2023 – 2024

Programme Scheme

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING (AUTONOMOUS)

SRI VENKATESWARA UNIVERSITY

TIRUPATI-517502 (A.P), INDIA.

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502

Department of Electronics and Communication Engineering-Scheme of Instruction- (CBCS) effective from the Academic Year 2023-2024

M.Tech (PG) (Electronics and Communication Engineering)
Specialization: Communication Systems (CM)

I Semester

S.No.	Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
				Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
1	PCC	CM11C	Advanced Digital Signal Processing (Common to Signal Processing SP11C)	3	1	0	4	4	40	60	100
2	PCC	CM12C	Wireless and Mobile Communication	3	1	0	4	4	40	60	100
3	PCC	CM13C	DSP Architecture (Common to Signal Processing SP13C)	3	1	0	4	4	40	60	100
4	PEC	CM14C	Programme Elective- I	3	0	0	3	3	40	60	100
5	PEC	CM15C	Programme Elective- II	3	0	0	3	3	40	60	100
6	PCC	CM16L	Advanced Digital Signal Processing Lab (Common to Signal Processing SP16L)	0	0	3	3	1.5	40	60	100
7	PCC	CM17L	Wireless and Mobile Communication Lab	0	0	3	3	1.5	40	60	100
8	MAC	CM18C	Research Methodology and IPR	3	0	0	3	3	40	60	100
Total				18	3	6	27	24	320	480	800

List of Programme Elective Course I(CM14C)	List of Programme Elective Course II(CM15C)
1. Optical Networks	1. Cognitive Radio
2. Statistical Information Processing	2. Voice and Data Networks (Common to signal Processing SP15C)
3. Wireless Sensor Networks (Common to signal Processing SP14C)	3. Secured Communication
4. High Performance Networks	**4.** Electromagnetic Interference and Compatibility

II Semester

S.No.	**Category**	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
				Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
1	PCC	CM21C	Antennas and Radiating Systems	3	1	0	4	4	40	60	100
2	PCC	CM22C	Advanced Communication Networks	3	1	0	4	4	40	60	100
3	PEC	CM23C	Programme Elective Course - III	3	0	0	3	3	40	60	100
4	PEC	CM24C	Programme Elective Course - IV	3	0	0	3	3	40	60	100
5	PCC	CM25L	Antennas and Radiating Systems Lab	0	0	3	3	1.5	40	60	100
6	PCC	CM26L	Advanced Communication Networks Lab	0	0	3	3	1.5	40	60	100
7	VAC	CM27C	Cyber Security	2	0	2	4	3	100	-	100
8	PCC	CM28M	Mini Project with Seminar	0	0	4	4	2	100	-	100
Total				**14**	**2**	**12**	**28**	**22**	**440**	**360**	**800**

List of Programme Elective Courses III(CM23C)	**List of Programme Elective Courses IV(CM24C)**
1. Satellite Communication	1. Random processes and Queueing models. (Common to Signal Processing SP24C)
2. IoT and Applications (Common to signal Processing SP23C)	2. Pattern Recognition and Machine Learning (Common to Signal Processing SP21C)
3. RF and Microwave Circuit Design	3. Programmable Networks-SDN, NFV
4. MIMO Systems	4. Remote Sensing (Common to Signal Processing SP24C)

III Semester

S.No.	Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
				Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
1	OEC	CM31C	Open Elective Course (Through MOOCS)	0	0	0	0	3	100	-	100
2	PCC	CM32I	Industrial/ Research Internship (Min of 4 Weeks)	0	0	0	0	3	100	-	100
3	PCC	CM33D	Dissertation Work Phase-I	0	0	24	24	12	40	60	100
Total				**0**	**0**	**20**	**20**	**18**	**240**	**60**	**300**

IV Semester

S.No.	Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
				Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
1	PCC	CM41D	Dissertation Work Phase-II and Viva-Voce	0	0	20	20	10 + 06 = 16	40	60	100
Total				**0**	**0**	**20**	**20**	**16**	**40**	**60**	**100**

M. Tech. (Electronics & Communication Engineering)
Curriculum Structure
Specialization: Communication systems (CM)

Vision of The Institute

The Vision of Sri Venkateswara University College of Engineering is to be the leader in the creation and development of globally competitive human capital in Engineering Education for Technological, Economical and Social Enrichment of the Society, through its open and flexible Academic Programs.

Mission of The Institute

- To be recognized as a premier institution offering Engineering Education programs, training human resources oriented to problem solving and system development.
- To carry out research in Engineering and Technology relevant to all segments of society.
- To assume leadership in sustainable technological growth of the Indian society.
- To be a natural destination for excellence and diversity in thought and practice.

Department of Electronics & Communication Engineering

Vision

To be a lead department imparting quality and value embedded higher education and research emphasizing freedom of learning andpractice.

Mission

1. Transforming students into full-fledged professionals and to become leaders in dynamic global environment.
2. Augmenting knowledge and technologies in rapidly advancing fields of Electronics and Communication Engineering.
3. Promoting in depth research and create Centre of excellence in thrust areas.

Program Outcomes (POs) for PG programs

POs are statements that describe what students are expected to know and be able to do upon graduating from the program. These relate to the skills, knowledge, analytical ability attitude and behaviour that students acquire through the program.

The POs essentially indicate what the students can do from subject-wise knowledge acquired by them during the program. As such, POs define the professional profile of a graduate of PG Engineering Program.

NBA has defined the following three POs for a graduate of PG Engineering Program:

1. **PO1**: An ability to independently carry out research/investigation and development work to solve practical problems.
2. **PO2**: An ability to write and present a substantial technical report/document.
3. **PO3**: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

Program Specific Outcomes (PSOs):

M. Tech. in Communication Systems graduates will be able to:

1. **PSO 1**. Integrate knowledge to identify, formulate, solve complex problems and meet the challenges in the domain of communication and networking.
2. **PSO 2.** Use the concepts of communications, networking and signal processing to simulate algorithms in virtual platforms and implement them in real time environment.

Program Educational Objectives (PEOs):

M. Tech. in Communication Systems Program, graduates will be able to:

. **PEO 1.** Apply the concepts of mathematics and engineering principles in the domain of communication and networking and analyze advantages and disadvantages of using the various communication technologies.
. **PEO 2.** Solve numerical problems and write algorithms using communication and networking platforms and different software tools to evolve viable communication systems.
. **PEO 3.** Inculcate professional ethics, integrity and social responsibility, enhance communication skills, and practice effective teamwork to pursue research or attain a career in the domain of Communication Engineering.

CM11C: Advanced Digital Signal Processing
(Common to signal processing)

Instruction Hours/week: (L-T-P-C): 3-1-0-4 **Credits : 4**
Sessional Marks : 40 **Semester-End Examination : 60**

Course Description: This course will provide rigorous foundations in Digital filter structures, Multirate signal processing, Linear prediction, Adaptive filters and Spectral estimation. This course emphasizes the use of digital signal processing techniques for designing digital systems used in Communications, Control, Media Applications etc.

Prerequisites: Signals and Systems, Digital Signal Processing.

Course Objectives: To enable the student to

1. Understand to develop FIR & IIR filter structures depending upon the given applications.
2. Understand theory of Multirate DSP, solve numerical problems and write algorithms.
3. Understand theory of prediction and solution of normal equations.
4. Understand the different types of adaptive filters used in signal processing applications.
5. Discuss different methods of spectrum estimation and analysis.

Course Outcomes: After completion of the course, student will be able to

1. Learn and implement the digital filters to computational complexity problems.
2. Analyze multirate DSP systems and Design a decimator and integrator including multi-stages.
3. Apply theory of prediction and find solution of normal equations
4. Design different types of filters such as Adaptive filters, poly phase filters, Wiener filters, ARMA lattice-ladder filters, etc.
5. Estimate the power spectrum by using different methods.

Contents:

Unit 1

Digital filter structures: Basic FIR/IIR filter structures, FIR/IIR Cascaded lattice structures, Parallel structures, all pass realization of IIR transfer functions, Sine- cosine generator, Computational complexity of filter structures.

Unit 2

Multirate Digital Signal Processing: Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, Quadrature mirror filter (QMF) banks, Conditions for perfect reconstruction, digital filter banks, Applications in sub-band coding.

Unit 3

Linear Prediction and Optimum Linear Filters: Innovations Representation of a Stationary Random Process, Forward and Backward linear prediction, Solution of the Normal Equations, Properties of linear prediction-Error Filter, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.

Unit 4

Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, The Least-Mean-Square (LMS) algorithm, Normalized LMS (NLMS), The Leaky LMS, Recursive Least Square (RLS) algorithm.

Unit 5

Power Spectral Estimation: Estimation of Spectra from Finite Duration Observations of a Signal, Periodogram, Use DFT in power Spectral Estimation, Bartlett, Welch and Blackman, Tukey methods, Comparison of performance of Non-Parametric Power Spectrum Estimation Methods.

Parametric Methods of Power Spectrum Estimation: Relationship between Auto-Correlation and Model Parameters, Yule-Walker, Burg and Unconstructrained Least Squares Methods, Moving Average (MA) and ARMA Models Minimum Variance Method, Eigen analysis Algorithms for Spectrum Estimation.

Text Books:

1. **John G. Proakis** and **Dimitris G. Manolakis,** Digital Signal Processing: Principles, Algorithms and Applications, 5th Edition, **ISBN-13: 9780137348657, Published** by Pearson, 2021.
2. John G. Proakis, Digital Signal Processing Principles, Algorithms, and Applications, Prentice Hall International Inc, 4th Edition, 2012.
3. Sanjit Kumar Mitra, Digital Signal Processing- A Computer Based Approach, 4th edition, McGraw Hill Education, 2011.
4. D.G. Manolakis, V.K. Ingle and S.M.Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.

References:

1. N. J. Flieg Multirate Digital Signal Processing: Multirate Systems - Filter Banks – Wavelets, 1st Edition, John Wiley and Sons Ltd, 1999.

2. Sanjit Kumar Mitra, and Yonghong Kuo. Digital Signal Processing: A Computer-Based Approach, 4 th. Edition McGraw-Hill Higher Education, New York, 2013.
3. M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc., 2002.
4. Simon Haykin, "Adaptive Filter Theory", 4th Edition, Prentice Hall, 2001.

CM12C: Wireless and Mobile Communication

Instruction Hours/week : (L-T-P-C): 3-1-0-4 **Credits : 4**

Sessional Marks : 40 **Semester-End Examination : 60**

Course Description: This course provides a comprehensive overview and advanced knowledge of modern mobile and wireless communication systems. Building on the prior knowledge on digital communications, students develop further understanding on the challenges and opportunities brought by the wireless medium in designing current and future wireless communication systems and networks

Course Objectives:

1. To provide the students with an understanding of the cellular concepts, frequency reuse, handoff strategies.
2. To enable the students to analyze and understand wireless and mobile cellular communication systems over stochastic fading channels.
3. To provide the students with an understanding of Co-channel and Non-Co channel Interference.
4. To give students an understanding of cell coverage for signal and traffic diversity techniques and mobile antennas.
5. To give the students an understanding of frequency management, channel assignment and types of handoff.

Contents

UNIT 1

Cellular Communication Fundamentals: Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, frequency management and channel assignment.GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, GPRS, IS 95, Forward Link and Reverse links.

UNIT 2

Spectral efficiency analysis based on calculations for Multiple access technologies: TDMA, FDMA and CDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas. Wireless network planning (Link budget and power spectrum calculations)

UNIT 3

Mobile Radio Propagation: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small-Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading.

UNIT 4

Equalization, Diversity: Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.

UNIT 5

5G Architecture Add Network, 5G Radio, Access Technologies, Security for 5G Communications, 5G challenges and future scope.

Course Outcomes: Upon completion of the course, students will be able to

1. Design appropriate mobile communication systems by applying frequency-reuse concept, and analyze its effects on interference, system capacity, handoff techniques.
2. Distinguish various multiple-access techniques e.g. FDMA, TDMA, CDMA, and their advantages and disadvantages.
3. Analyze path loss and interference for wireless telephony and their influences on a mobile communication system's performance.
4. Analyze and design CDMA system with the knowledge of forward and reverse channel details, advantages and disadvantages of it.
5. Understand technologies like 2G, 3G, 4G, 5G, etc.

TEXT BOOKS:

1. T.S.Rappaport, "Wireless Communications Principles and Practice", 2nd edition, PHI, 2002.
2. William C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH, 1995.
3. Ajit Singh, "5G Simplified", Shroff Publishers, 2019.

REFERENCES:

1. V.K.Garg, J.E.Wilkes, "Principle and Application of GSM", Pearson Education, 5th edition, 2008.
2. V.K.Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th edition, 2009.
3. Asha Mehrotra, "A GSM system Engineering" Artech House Publishers Bosten, London,1997.

CM13C: DSP Architecture
(Common To Signal Processing)

Instruction Hours/week : (L-T-P-C): 3-1-0-4 Credits : 4
Sessional Marks : 40 Semester-End Examination : 60

Course Description: This course explains fundamental concepts of Digital Signal Processing and implementation of various applications on Advanced Processor. Helps students to understand architecture of advanced Digital Signal Processor and how to program it for signal processing applications.

Course Objectives:
1. To describe features and architectural improvements of DSP processors.
2. Introduce addressing modes and instruction description of TMS320C6x processors.
3. To demonstrate data representation in DSP Processors and FIR filters.
4. To demonstrate the usefulness of the adaptive filters and learn techniques of code optimization.

Course Outcomes:
1. At the end of this course, students will be able to
2. Identify and formalize architectural level characterization of P-DSP hardware
3. Ability to design, programming (assembly and C), and testing code using Code Composer Studio environment
4. Deployment of DSP hardware for Control, Audio and Video Signal processing applications
5. Understanding of major areas and challenges in DSP based embedded systems

Syllabus Contents:

Unit 1

Programmable DSP Hardware: Processing Architectures (von Neumann, Harvard), DSP core algorithms (FIR, IIR, Convolution, Correlation, FFT), IEEE standard for Fixed and Floating Point Computations, Special

Architectures Modules used in Digital Signal Processors (like MAC unit, Barrel shifters), On-Chip peripherals, DSP benchmarking.

Unit 2

Structural and Architectural Considerations: Parallelism in DSP processing, Texas Instruments.TMS320 Digital Signal Processor Families, Fixed Point TI DSP Processors: TMS320C1X and TMS320C2X Family,TMS320C25 – Internal Architecture, Arithmetic and Logic Unit, Auxiliary Registers, Addressing Modes (Immediate, Direct and Indirect, Bit-reverse Addressing), Basics of TMS320C54x and C55x Families in respect of Architecture improvements and new applications fields, TMS320C5416 DSP Architecture, Memory Map, Interrupt System, Peripheral Devices, Illustrative Examples for assembly coding.

Unit 3

VLIW Architecture: Current DSP Architectures, GPUs as an alternative to DSP Processors, TMS320C6X Family, Addressing Modes, Replacement of MAC unit by ILP, Detailed study of ISA, Assembly Language Programming, Code Composer Studio, Mixed Cand Assembly Language programming, On-chip peripherals, Simple applications developments as an embedded environment.

Unit 4

Multi-core DSPs: Introduction to Multi-core computing and applicability for DSP hardware, Concept of threads, introduction to P-thread, mutex and similar concepts, heterogeneous and homogenous multi-core systems, Shared Memory parallel programming –OpenMP approach of parallel programming, PRAGMA directives, OpenMP Constructs for work sharing like for loop, sections, TI TMS320C6678 (Eight Core subsystem).

Unit 5

FPGA based DSP Systems: Limitations of P-DSPs, Requirements of Signal processing for Cognitive Radio (SDR), FPGA based signal processing design-case study of a complete design of DSP processor,High Performance Computing using P-DSP: Preliminaries of HPC, MPI, OpenMP, multicore DSP as HPC infrastructure.

References:

1. M. Sasikumar, D. Shikhare, Ravi Prakash, “Introduction to Parallel Processing”, 1st Edition, PHI, 2006.
2. Fayez Gebali, “Algorithms and Parallel Computing”,1st Edition, John Wiley & Sons, 2011
3. Rohit Chandra, Ramesh Menon, Leo Dagum, David Kohr, DrorMaydan,

Jeff McDonald,"Parallel Programming in OpenMP", 1st Edition, Morgan Kaufman,2000.
4. Ann Melnichuk,Long Talk, "Multicore Embedded systems", 1st Edition, CRC Press,2010.
5. Wayne Wolf, "High Performance Embedded Computing: Architectures, Applications and Methodologies", 1st Edition, Morgan Kaufman, 2006.
6. E.S.Gopi, "Algorithmic Collections for Digital Signal Processing Applications Using MATLAB", 1st Edition, Springer Netherlands, 2007.

CM14C: Program Elective-I
1. Optical Networks

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination : 60**

Course Description: Optical fibers have several advantages over conventional copper cables. Optical communication enjoys high bandwidth and thus useful for transmitting huge information securely and with less repeaters to longer distances. The performance of optical system is superior to conventional communication and thus has widespread use in industry.

Course Objectives: Optical Communication has got greater applicability and students of Communication discipline should master the subject. This course will enable the students:
1. To understand deeply the fundamental aspects of optical communication
2. To analyze the types of fibers and understand the performance by comparison
3. To design optical receivers of optical systems
4. To simulate the performance through parameters like BER and S/N Ratio
5. To apply the principles of optical communication to networks.

Course Outcomes:
At the end of this course, students will be able to
1. Contribute in the areas of optical network and WDM network design.
2. Implement simple optical network and understand further technology developments for future enhanced network.

Syllabus Contents:

Unit 1
SONET/SDH: optical transport network, IP, routing and forwarding, multiprotocol label switching.
WDM network elements: optical line terminals and amplifiers, optical add/dropmultiplexers, OADM architectures, reconfigurable OADM, optical cross connects.

Unit 2

Control and management: network management functions, optical layer services and interfacing, performance and fault management, configuration management, optical safety.

Unit 3

Network Survivability: protection in SONET/SDH & client layer, optical layer protection schemes

Unit 4

WDM network design: LTD and RWA problems, dimensioning wavelength routingnetworks, statistical dimensioning models.

Unit 5

Access networks: Optical time division multiplexing, synchronization, header processing,buffering, burst switching, test beds, Introduction to PON, GPON, AON.

References:

1. Rajiv Ramaswami, Sivarajan, Sasaki, "Optical Networks: A Practical Perspective", MK, Elsevier, 3 rd edition, 2010.
2. C. Siva Ram Murthy and Mohan Gurusamy, "WDM Optical Networks: Concepts Design, and Algorithms", PHI, EEE, 2001.

CM14C: Program Elective-I
2. Statistical Information Processing

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination : 60**

Course Outcomes:

At the end of this course, students will be able to

1. Characterize and apply probabilistic techniques in modern decision systems, such as information systems, receivers, filtering and statistical operations.
2. Demonstrate mathematical modelling and problem solving using such models.
3. Comparatively evolve key results developed in this course for applications to signal processing, communications systems.
4. Develop frameworks based in probabilistic and stochastic themes for modelling and analysis of various systems involving functionalities in decision making, statistical inference, estimation and detection.

Syllabus Contents:

Unit 1

Review of random variables: Probability Concepts, distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of Random variables, Vector quantization, Tchebay chef inequality theorem, Central Limit theorem, Discrete &Continuous Random Variables.

Random process: Expectations, Moments, Ergodicity, Discrete-Time Random Processes Stationary process, autocorrelation and auto covariance functions, Spectral representation of random signals, Properties of power spectral density, Gaussian Process and White noise process.

Unit 2

Random signal modelling: MA(q), AR(p), ARMA(p,q) models, Hidden Markov Model &its applications ,Linear System with random input , Forward and Backward Predictions, Levinson Durbin Algorithm.

Unit 3

Statistical Decision Theory: Bayes' Criterion, Binary Hypothesis Testing, M-aryHypothesis Testing, Minimax Criterion, Neyman-Pearson Criterion, Composite Hypothesis Testing.

Parameter Estimation Theory: Maximum Likelihood Estimation, Generalized Likelihood Ratio Test ,Some Criteria for Good Estimators, Bayes' Estimation Minimum Mean-Square Error Estimate, Minimum, Mean Absolute Value of Error Estimate Maximum A Posteriori Estimate , Multiple Parameter Estimation Best Linear Unbiased Estimator ,Least-Square Estimation Recursive Least-Square Estimator.

Unit 4

Spectral analysis: Estimated autocorrelation function, Periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Parametric method, AR(p) spectral estimation and detection of Harmonic signals.

Information Theory and Source Coding: Introduction, Uncertainty, Information and Entropy, Source coding theorem, Huffman, ShanonFano , Arithmetic , Adaptive coding , RLE , LZW Data compaction, , LZ-77, LZ-78. Discrete Memory less channels, Mutual information, channel capacity, Channel coding theorem, Differential entropy and mutual information for continuous ensembles.

Unit 5

Application of Information Theory: Group, Ring & Field, Vector, GF

addition,multiplication rules. Introduction to BCH codes, Primitive elements ,Minimal polynomials, Generator polynomials in terms of Minimal polynomials, Some examples of BCH codes,& Decoder, Reed- Solomon codes & Decoder, Implementation of Reed Solomon encoders and decoders.

References:

1. Papoulis and S.U. Pillai, "Probability, Random Variables and Stochastic Processes",4th Edition, McGraw-Hill, 2002.
2. D.G. Manolakis, V.K. Ingle and S.M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.
3. Mourad Barkat , "Signal Detection and Estimation", Artech House, 2nd Edition, 2005.
4. R G. Gallager, "Information theory and reliable communication", Wiley, 1st edition, 1968.
5. F. J. MacWilliams and N. J. A. Sloane, "The Theory of Error-Correcting Codes", NewYork, North-Holland, 1977.
6. Rosen K.H, "Elementary Number Theory", Addison-Wesley, 6th edition, 2010.

CSPE13: Program Elective-I
3. Wireless Sensor Networks

Instruction Hours/week: 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination : 60**

Course Description: This course offers an insight into the concepts of mobile and wireless data communication technologies. The objective of this course is to enable the student to understand the emerging technologies of wireless and mobile communications and simulate them.

Course Objectives:

1. To understand the new trends in mobile/wireless communications networks.
2. To understand multiple radio access techniques.
3. To analyze various routing algorithms used in mobile/wireless networks.
4. To identify the issues in transport and application layers.

Course Outcomes:

At the end of this course, students will be able to

1. Design wireless sensor network system for different applications under consideration.
2. Understand the hardware details of different types of sensors and select right type of sensor for various applications.
3. Understand radio standards and communication protocols to be used for wireless sensor network based systems and application.

4. Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms.
5. Handle special issues related to sensors like energy conservation and security challenges.

Syllabus Contents:

Unit 1

Introduction and overview of sensor network architecture and its applications, sensornetwork comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.

Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun

SPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.

Unit 2

Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)

Unit 3

Overview of sensor network protocols (details of atleast 2 important protocol per layer):Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy), UWB.

Unit 4

Data dissemination and processing; differences compared with other database management systems, data storage; query processing.

Unit 5

Specialized features: Energy preservation and efficiency; security challenges; fault-tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network.

References:

1. 1.H. Karl and A. Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, India, 2012.
2. C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, “Wireless Sensor Networks”, Springer Verlag, 1st Indian reprint, 2010.
3. F. Zhao and L. Guibas, “Wireless Sensor Networks: An Information Processing Approach”, Morgan Kaufmann, 1st Indian reprint, 2013.

4. YingshuLi, MyT. Thai, Weili Wu, “Wireless sensor Network and Applications”, Springer
5. Series on signals and communication technology, 2008.

CM14C: Program Elective-I
4. High Performance Networks

Instruction Hours/week: 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination :60**

Course Description: This course provides an introduction to voice and data networking technologies, including public and private voice services, Ethernet and Internet data technologies, network security, business applications and net work management. The structure, regulation, andhistory of the telecom and data network industry will be discussed as well.

Course Objectives:
1. To protocol, algorithms, trade-offs rationale.
2. To routing, transport, DNS resolutions
3. To network extensions and next generation architecture.

Course Outcomes:

At the end of this course, students will be able to
1. Apply knowledge of mathematics, probability, and statistics to model and analyze some networking protocols.
2. Design, implement, and analyze computer networks.
3. Identify, formulate, and solve network engineering problems.
4. Show knowledge of contemporary issues in high performance computer networks. Use techniques, skills, and modern networking tools necessary for engineering practice.

Syllabus Contents:

Unit 1
Types of Networks, Network design issues, Data in support of network design. Networkdesign tools, protocols and architecture. Streaming stored Audio and Video, Best effort service, protocols for real time interactive applications, Beyond best effort, scheduling and policing mechanism, integrated services, and RSVP-differentiated services.

Unit 2
VoIP system architecture, protocol hierarchy, Structure of a voice endpoint, Protocols forthe transport of voice media over IP networks. Providing IP quality of service for voice, signaling protocols for VoIP, PSTN gateways, VoIP applications.

Unit 3

VPN-Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN. MPLS-operation, Routing, Tunneling and use of FEC, Traffic Engineering, MPLS based VPN, overlay networks-P2P connections.

Unit 4

Traffic Modeling: Little's theorem, Need for modeling, Poisson modeling, Non-poissonmodels, Network performance evaluation.

Unit 5

Network Security and Management: Principles of cryptography, Authentication, integrity,key distribution and certification, Access control and fire walls, attacks and counter measures, security in many layers.Infrastructure for network management, The internet standard management framework –SMI, MIB, SNMP, Security and administration, ASN.1.

References:

1. 1.Kershenbaum A., "Telecommunications Network Design Algorithms", Tata McGraw Hill, 1993.
2. Larry Peterson & Bruce David, "Computer Networks: A System Approach", Morgan Kaufmann, 2003.
3. Douskalis B., "IP Telephony: The Integration of Robust VoIP Services", Pearson Ed. Asia, 2000.
4. Warland J., Varaiya P., "High-Performance Communication Networks", Morgan Kaufmann, 1996.
5. Stallings W., "High-Speed Networks: TCP/IP and ATM Design Principles", Prentice Hall, 1998.
6. Leon Garcia, Widjaja, "Communication networks", TMH 7threprint 2002.
7. William Stalling, "Network security, essentials", Pearson education Asia publication, 4th Edition, 2011.

CM15C: Program Elective-II
1.Cognitive Radio

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination : 60**

Course Description: To understand the fundamental concepts of cognitive radios networks and develop the cognitive radio, as well as techniques for spectrum holes detection that cognitive radio takes advantages in order to exploit it. Technologies to allow an efficient use of TVWS for radio communications based on two spectrum sharing business models.

Course Objectives:

1. To understand the fundamental concepts of cognitive radio networks and develop the cognitive radio, as well as techniques for spectrum holes detection that cognitive radio takes advantages in order to exploit it.
2. Understand technologies to allow an efficient use of TVWS for radio communications based on two spectrum sharing business models/policies

Course Outcomes:

At the end of this course, students will be able to

1. Understand the fundamental concepts of cognitive radio networks.
2. Develop the cognitive radio, as well as techniques for spectrum holes detection that cognitive radio takes advantages in order to exploit it.
3. Understand technologies to allow an efficient use of TVWS for radio communications based on two spectrum sharing business models/policies
4. Understand fundamental issues regarding dynamic spectrum access, the radio-resource management and trading, as well as a number of optimisation techniques for better spectrum exploitation.

Syllabus Contents:

Unit 1

Introduction to Cognitive Radios: Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum access (DSA), components of cognitive radio, spectrum sensing, spectrum analysis and decision, potential applications of cognitive radio.

Unit 2

Spectrum Sensing: Spectrum sensing, detection of spectrum holes (TVWS), collaborative sensing, geo-location database and spectrum sharing business models (spectrum of commons, real time secondary spectrum market).

Unit 3

Optimization Techniques of Dynamic Spectrum Allocation: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming.

Unit 4

Dynamic Spectrum Access and Management: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols.

Unit 5

Spectrum Trading: Introduction to spectrum trading, classification to spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), classification of auctions (single auctions, double auctions, concurrent, sequential).

Research Challenges in Cognitive Radio: Network layer and transport layer issues, cross-layer design for cognitive radio networks.

References:

1. Ekram Hossain, Dusit Niyato, Zhu Han, "Dynamic Spectrum Access and Management in Cognitive Radio Networks", Cambridge University Press, 2009.
2. Kwang-Cheng Chen, Ramjee Prasad, "Cognitive radio networks", John Wiley & Sons Ltd., 2009.
3. Bruce Fette, "Cognitive radio technology", Elsevier, 2nd edition, 2009.
4. Huseyin Arslan, "Cognitive Radio, Software Defined Radio, and Adaptive Wireless ,Systems", Springer, 2007.
5. Francisco Rodrigo Porto Cavalcanti, Soren Andersson, "Optimizing Wireless Communication Systems" Springer, 2009.
6. Linda Doyle, "Essentials of Cognitive Radio", Cambridge University Press, 2009.

CM15C :Program Elective-II
2. Voice and Data Networks
(Common to signal processing)

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination : 60**

Course Description: This course provides an introduction to voice and data networking technologies, including design and performance issues. And also focus is on layered & cross layer communication along with Packet and circuit switching communication. Provides Link layer error and flow control mechanisms, also know about queuing models of networks and its applications. Finally have idea about different internet protocols and packet scheduling algorithm.

Course Objectives:

1. Know different design and performance issues of communications networks.
2. Understand the concepts of layered & cross layer communication, along with circuit & packet switching technologies and their deployments in public networks
3. Understand the role of data link layer and various queuing models for

communication.
4. Understand the functions of internetworking devices and importance of different internet protocols.

Course Outcomes:

1. An ability to apply knowledge of networking. network topologies in designing of a network.
2. An ability to model systems using concept of layered/cross layered and TCP/IP architecture.
3. An ability apply the link layer functionalities and queuing models during communication.
4. An ability to use modern engineering techniques for analysis and design of a network with the knowledge of internet concepts and protocols.

Syllabus Contents:

Unit 1

Network Design Issues, Network Performance Issues, Network Terminology, centralized and distributed approaches for networks design, Issues in design of voice and data networks.

Unit 2

Layered and Layer less Communication, Cross layer design of Networks, Voice Networks (wired and wireless) and Switching, Circuit Switching and Packet Switching, Statistical Multiplexing.

Unit 3

Data Networks and their Design, Link layer design- Link adaptation, Link Layer Protocols, Retransmission. Mechanisms (ARQ), Hybrid ARQ (HARQ), Go Back N, Selective Repeat protocols and their analysis.

Unit 4

Queuing Models of Networks , Traffic Models , Little's Theorem, Markov chains, M/M/1 and other Markov systems, Multiple Access Protocols , Aloha System , Carrier Sensing , Examples of Local area networks,

Unit 5

Inter-networking, Bridging, Global Internet, IP protocol and addressing, Sub netting, Classless Inter domain Routing (CIDR) , IP address lookup , Routing in Internet. End to End Protocols, TCP and UDP. Congestion Control, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit/ Fast Recovery, Congestion avoidance, RED TCP Throughput Analysis, Quality of Service in Packet Networks, Network Calculus, Packet Scheduling Algorithms.

References:

1. D. Bertsekas and R. Gallager, "Data Networks", 2nd Edition, Prentice Hall, 1992.
2. L. Peterson and B. S. Davie, "Computer Networks: A Systems Approach",5th Edition, Morgan Kaufman, 2011.
3. Kumar, D. Manjunath and J. Kuri, "Communication Networking: An analytical approach", 1st Edition, Morgan Kaufman, 2004.
4. Walrand,"Communications Network: A First Course", 2nd Edition, McGraw Hill, 2002.
5. Leonard Kleinrock, "Queueing Systems,Volume I: Theory", 1st Edition, John Wiley and Sons, 1975.
6. Aaron Kershenbaum,Telecommunication Network Design Algorithms, McGraw Hill, 1993.
7. Vijay Ahuja, "Design and Analysis of Computer Communication Networks", McGraw Hill, 1987

CM15C: Program Elective-II
3. Secured Communication

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination : 60**

Course Description: The principles are tempered with their practical significance to cope up with the interest to both researchers and system designers. Learning is facilitated by streamlined derivations and assignments.

Course Objectives:

1. To introduce the basic concept encryption techniques
2. To familiarize with the concept of private key and public key cryptosystems.
3. To introduce the concept of Elliptic curves

Course Outcomes: After completing this course, students will be able to:

1. To Understand Cryptography attacks, Integer arithmetic, linear congruence
2. To Understand encryption techniques
3. To Understand Private key and public cryptosystem
4. To Understand Elliptic Curves
5. Discrete logarithm problem on Elliptic Curves

UNIT 1

Introduction: Security Goals, Cryptographic Attacks, Services and Mechanisms, Integer Arithmetic, Modular Arithmetic, Linear Congruence.

UNIT 2

Basic Encryption Techniques: Concept of cryptanalysis ,Symmetric key ,Block ciphers, Cryptographic algorithms , Features of DES, Stream ciphers, Pseudo random sequence generators, linear complexity, Non-linear combination of LFSRs ,Boolean functions.

UNIT 3

Private Key and Public Key Cryptosystems: Asymmetic Key, One way functions, Primality Testing, Factorization problem, Chinese Remainder Theorem , RSA encryption, Diffie Hellmann key exchange , Message authentication and hash functions, Digital signatures, Secret sharing, features of visual cryptography , other applications of cryptography.

UNIT 4

Elliptic Curves: Basic theory, Weirstrass equation, Group law, Point at Infinity, Elliptic curves over finite fields.

UNIT 5

Discrete logarithm problem on Elliptic curve: Elliptic curve cryptography, Diffie Hellmann key exchange over EC, Elgamal encryption over EC, ECDSA.

Text Books:

1. Douglas R. Stinson, Maura B. Paterson "Cryptography, Theory and Practice", 4th Edition, CRC Press, Taylor & Francis Group, 2019.
2. Lawrence C. Washington, " Elliptic Curves", **2nd Edition** , Chapman & Hall/ CRC Press Publishers, April 2008, ISBN: 9781420071474.
3. David S. Dummit, Richard M. Foote, " Abstract Algebra", Third Edition John Wiley & Sons, Inc., 2004.

CM15C: Program Elective-II
4. Electromagnetic Interference And Compatibility

Instruction Hours/Week:3L **Credits: 3**

Sessional Marks :40 **End Semester Examination Marks: 60**

Course objective:

1. The course Electromagnetic interference and compatibility gives the in-depth expose of unintentional generation, propagation and reception of electromagnetic energy which may cause unwanted effects such as

electromagnetic interference or even physical damage to the operational or impaired function of equipment.

2. The goal of EMC is to inbuilt the withstanding capability of operation of different equipment in a common electromagnetic environment. This course will equip the learner's in-depth understanding of Sources and victim of EMI. The course gives the insight of the suppression techniques like Shielding, bonding Grounding, Earthing.
3. Learners should be able to explore and apply EMI/EMC measurement technique, evaluation methods and various EMI/EMC standards.
4. A Prerequisite knowledge of Antennas and Microwave Engineering is required for the course.

Syllabus Contents:

UNIT I

BASIC THEORY (10): Introduction to EMI and EMC, Intra and inter system EMI, Elements of Interference, Sources and Victims of EMI, Conducted and Radiated EMI emission and susceptibility, Case Histories, Radiation hazards to humans, Various issues of EMC, EMC Testing categories, EMC Engineering Application. Importance of EMI emission in communications.

UNIT II

EMI from Apparatus and circuits (10): Electromagnetic emissions, noise from relays and switches, non-linearities in circuits, passive inter-modulation, cross-talk in transmission lines, transients in power supply lines, electromagnetic interference(EMI), Overview on Open area test sites and measurements

UNIT III

Radiated and Conducted Interference Measurements (10): Anechoic chamber, TEM cell, GH TEM cell, characterization of conduction Currents/voltages, conducted EM noise on power lines, conducted EMI from Equipment, immunity to conducted EMI detectors and Measurements.

UNIT IV

STANDARDS AND REGULATION (10): Need for Standards, Generic/General Standards for Residential and Industrial environment, Basic Standards, Product Standards, National and International EMI Standardizing Organizations; IEC, ANSI, FCC, CISPR, CENELEC, Electro Magnetic Emission and susceptibility standards and specifications, MIL461E Standards.

UNIT V

EMI TEST METHODS AND INSTRUMENTATION (10): Fundamental

considerations, Basic principles of RE, CE, RS and CS measurements, EMI Shielding effectiveness tests, TEM cell for immunity test, Shielded chamber , Shielded anechoic chamber, EMI test receivers, Spectrum analyzer, EMI test wave simulators, EMI coupling networks, Line impedance stabilization networks, Feed through capacitors, Antennas, Current probes, MIL -STD test methods, Civilian STD test methods.

TEXT BOOK

1. Clayton Paul, "Introduction to Electromagnetic Compatibility", Wiley Interscience, 2006.
2. V Prasad Kodali, "Engineering Electromagnetic Compatibility", IEEE Press, Newyork, 2001.

REFERENCES

1. Henry W. Ott, "Electromagnetic Compatibility Engineering", John Wiley & Sons Inc, Newyork, 2009.
2. Daryl Gerke and William Kimmel, "EDN's Designer's Guide to Electromagnetic Compatibility", Elsevier Science & Technology Books, 2002.
3. W Scott Bennett, "Control and Measurement of Unintentional Electromagnetic Radiation", John Wiley & Sons Inc., (Wiley Interscience Series) 1997.
4. Dr Kenneth L Kaiser, "The Electromagnetic Compatibility Handbook", CRC Press 2005.

COURSE OUTCOMES:

1. Identify the various types and mechanisms of Electromagnetic Interference
2. Identify the various types and mechanisms of Electromagnetic Interference Analyze various sources of EMI and various possibilities to provide EMC.
3. Analyze possible EMI prevention techniques such as grounding, shielding, filtering and use of proper coupling mechanisms to improve compatibility of electronic circuits and systems in a given electromagnetic environment.
4. To measure emission immunity level from different systems to couple with the prescribed EMC standards
5. Understand the different types of EMI/EMC measurement techniques and measuring equipment

CM16L: Advanced Digital Signal Processing Lab
(Common to signal Processing)

Instruction Hours/week : 3(P) **Credits : 1.5**
Sessional Marks : 40 **Semester-end Examination : 60**

Course Overview: This practical course enables students to apply skills learned in Advanced Digital Signal Processing algorithms and will help to teach implementation of them. MATLAB is used to apply theoretical concepts and to demonstrate signal processing techniques by means of hands-on application examples. Recognize estimation problems and design, implement and analyze algorithms for solving them. Implement signal processing systems with DSP based development platforms.

Pre-requisites: Signals & Systems, Digital Signal Processing, Digital Signal Processing Lab, MATLAB, and Code Composer Studio.

Course Learning Objectives: The student after studying this courseis able to:

1. Understand how to analyze and manipulate digital signals and have the programming knowledge to do so.
2. Understand the trade-offs in the practical design and implement of various structures of FIR and IIR digital filters, for example which can be reduces noise or realizes various applications.
3. Understand theory of prediction and solution of normal equations.
4. Acquaint knowledge of the concepts, algorithms and applications of adaptive signal processing in digital communication systems.
5. Understand the implementation of adaptive filters used in signal processing applications.
6. Understand different methods for estimation of power spectra and its analysis.

Course Outcomes: After completion of this coursethe student is:

1. Able to design, analyze, and implement digital filters using MATLAB.
2. Able to implement various structures of digital filters.
3. Able to implement up-sampling and down-sampling of a given Sequences.
4. Apply the Lattice filter architecture and implement the Wiener filter, Least Squares, LMS and RLS algorithms, and apply to selected applications.
5. Deduce and apply correlation functions and power spectra for various signal classes, in particular for stochastic signals.

Course Contents:

Note: (i) Minimum of 10 Experiments have to be done invariably.
(ii) All Experiments may be Simulated using MATLAB and to be

verified theoretically.

List of Experiments:

1. Introduction to DSP with MATLAB Programming Environment and Familiarization to Code Composer Studio.
2. Basic Operations on Signals, Generation of Various Signals and finding its FFT.
3. Simple Digital Filters (LPF, HPF, BPF, BSF and Comb Filters).
4. Realization of Structures (Cascade / Parallel/ Lattice Structure's) of a system transfer function.
5. Implement Program to verify Decimation and Interpolation of a given Sequences.
6. Implement Program to Convert CD data into DVD data (sampling rate converters).
7. Estimation of data series using Nth order Forward Predictor and comparing to the Original Signal.
8. Design of linear prediction coding (LPC) filter using Levinson-Durbin Algorithm.
9. Apply the Lattice filter architecture from the Levinson-Durbin algorithm.
10. Computation of Reflection Coefficients using Schur Algorithm.
11. To implement the Wiener filter, and Least Squares algorithms, and apply to selected applications.
12. To implement the LMS and RLS algorithms, and apply to selected applications.
13. Design and verification of a Matched filter.
14. Adaptive Noise Cancellation / Linear Equalizer.
15. Computing Power Spectrum of a Square Signal and chirp signal.
16. Design and Simulation of Notch Filter to remove 50Hz Hum / any unwanted frequency component of given Signal (Speech / ECG).
17. Plot the Periodogram of a Noisy Signal and estimate PSD using Periodogram and Modified Periodogram methods.
18. Estimation of Power Spectrum using Bartlett and Welch methods.
19. Parametric methods (Yule-Walker and Burg) of Power Spectrum Estimation.

For Motivated Learners Extra experiments can be done:

Applications: Adaptive filter and experiments on communication such as generation of a N-tuple PN sequence, generation of a white noise sequence using the PN sequence, restoration of a sinusoidal signal embedded in white noise by Wiener Filtering; speech and multi-media applications.

Texts / References:

1. **John G. Proakis** and **Dimitris G. Manolakis,** Digital Signal Processing:

Principles, Algorithms and Applications, 5th Edition, **ISBN-13: 9780137348657, Published** by Pearson, 2021.
2. Sanjit Kumar Mitra, Digital Signal Processing: A Computer Based Approach, 4th edition, McGraw Hill Education, 2011.
3. LjiljanaMilić, Multirate Filtering for Digital Signal Processing: MATLAB Applications, Published by Information Science Reference, Hershey PA 17033, New York, ISBN 978-1-60566-178-0 (Hardcover) - ISBN 978-1-60566-179-7 (eBook), 2009.
4. R. Chassaing and D. Reay, Digital Signal Processing and Applications withTMS320C6713 *and* TMS320C6416, Wiley, 2008.

CM17L: Wireless and Mobile Communication Lab

Instruction Hours/week : 3(P) **Credits : 1.5**
Sessional Marks : 40 **Semester-end Examination : 60**

Course Objectives:

1. To enable the students to understand and investigate Wireless channels, Fading environment and analyze their behaviour.
2. To study various radio propagation models.
3. To describe different algorithms of adaptive filtering.
4. To facilitate students with hands on 4G LTE network to establish communication between user equipment.

List of Experiments

1. Radio propagation models: Okumura and Hata models.
2. Calculation of frequency reuse factor and cluster size.
3. Improving channel capacity of wireless network using cell sectoring.
4. Selection diversity for wireless communication.
5. Power spectral density of GMSK.
6. RLS and LMS algorithms for adaptive filtering.
7. Configuration of processor and IP address for 4G LTE operation.
8. Configuration of eNodeB Radio parameters and Bandwidth.
9. Configuration of EPC and user database.
10. Configuration of IMS and users, complete LTE run and UE application setup.
11. Virtual lab experiments on understanding of pathloss, beam patterns, calculation of boundary coverage probability and SINR.
12. Virtual lab experiments on handoff, frequency reuse, flat and frequency selective fading.

Course Outcomes:

Upon completion of the course, students will be able to

1. Understand Cellular concepts and radio propagation models.
2. Perform 4G LTE wireless network through experimentation
3. Analyze configuration parameters of Software Defined Radio in real time environment.
4. Demonstrate various concepts of wireless and mobile communication like handoff, cell sectoring, frequency reuse, etc., using virtual labs.

Resources:

1. Software Tools: Matlab
2. Amitec 4G LTE Network Setup
3. Virtual Labs: Fading Channels and Mobile Communications, http://vlabs.iitkgp.ernet.in/fcmc

CM18C: Research Methodology and IPR

Instruction Hours/week : 3L **Credits:3**
Sessional Marks : 40 **Semester-end Examination : 60**

Description of the Course: This subject gives how to proceed systematically for research, present research findings. This course consists of basics of research methods, paper writing, patenting methods and requirements.

Course Educational Objectives (CEOs):

1. To understand the importance of research objectives and procedures.
2. To know the procedures of data collection and report writing of research.
3. To have the knowledge of filing and obtaining a patent on research findings.

UNIT I

Meaning, Objective and Motivation in Research: Types of Research, Research Approaches, Research Process, Validity and Reliability in Research, Research Design: Features of Good Design, Types of Research Design, Basic Principles of Experimental Design

UNIT II

Sampling Design: Steps in Sampling Design, Characteristics of a Good Sample Design, Random Samples and Random Sampling Design Measurement and Scaling Techniques: Errors in Measurement, , Scaling and Scale Construction techniques, Forecasting Techniques, Time Series

Analysis, Interpolation and Extrapolation

UNIT III

Methods of Data Collection: Primary Data, Questionnaire and Interviews, Collection of Secondary Data, Cases and Schedules. Professional Attitude and Goals, Concept of Excellence, Ethics in Science and Engineering, Correlation and Regression Analysis, Method of Least Squares, Regression Vs. Correlation, Correlation Vs. Determination.

UNIT IV

Interpretation of Data and Report Writing, Layout of a Research Paper, Techniques o f Interpretation. Making Scientific Presentation at Conferences and Popular Lectures to Semi Technical Audience, Participating in Pubic Debates on Scientific Issues

UNIT V

Nature of Intellectual property rights, Patents, designs, trademarks and copyrights, History of patenting, process of patenting, patent development, international cooperation on IPR, procedure of granting patent, patent rights, licensing and transferring technology, Geographical Indications ,IPR in biological and systems and software.

Text/Reference Books:

1. Research Methodology: Methods And Techniques - C. R. Kothari,2nd Edition, New Age Intemational Publishers.
2. Statistical Methods - S P. Gupta. S. chand& Sons, New Derhi.
3. Intellectual ProPerty-the law of trademarks, copyrights, Patents, and trade Secrets- Deborah E. Bouchoux, Esq.Georgetown University, Fourth edition

Course Outcomes (COs):

1. 1.Able to know research importance and requirements and procedure
2. Able to apply sampling techniques for analysis and forecasting.
3. Able to use methods for data collection and analyze the data using different mathematical techniques.
4. Able to write report on research done and present the research findings in systematic manner.
5. Able to have the knowledge to file and obtain patent on research finding.

Semester II

CM21C: Antennas and Radiating Systems

Instruction Hours/week : (L-T-P-C): 3-1-0-4 **Credits : 4**

Sessional Marks : 40 **Semester-end Examination :60**

Course Description: To understand the fundamental principles of antenna theory and to apply them to analysis and design. Because there are so many methods of analysis and design and different antenna structures, applications are made to some of the most basic and practical configurations such as linear dipoles, loops, arrays, aperture antennas, horn antennas, microstrip antennas and reflector antennas.

Course Objectives:

1. To fundamental antenna parameters and numerical methods to analyze and differentiate the antennas.
2. To concept of radiation mechanism of various antennas.
3. To mechanism and models for radio-wave propagation.

Course Outcomes:

At the end of this course, students will be able to

1. Compute the far field distance, radiation pattern and gain of an antenna for given current distribution.
2. Estimate the input impedance, efficiency and ease of match for antennas.
3. Compute the array factor for an array of identical antennas.
4. Design antennas and antenna arrays for various desired radiation pattern characteristics.

Syllabus Contents:

Unit 1

Types of Antennas: Wire antennas, Aperture antennas, Micro strip antennas, Arrayantennas Reflector antennas, Lens antennas, Radiation Mechanism, Current distribution on thin wire antenna.

Fundamental Parameters of Antennas: Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth, Polarization, Input Impedance, radiation efficiency, Antenna Vector effective length, Friis Transmission equation, Antenna Temperature.

Unit 2

Linear Wire Antennas: Infinitesimal dipole, Small dipole, Region separation, Finite lengthdipole, half wave dipole, Ground effects.

Loop Antennas: Small Circular loop, Circular Loop of constant current, Circular loop with non uniform current.

Unit 3

LinearArrays: Two element array, N Element array: Uniform Amplitude and spacing,Broadside and End fire array, Super directivity, Planar array, Design consideration.

Unit 4

Aperture Antennas: Huygen's Field Equivalence principle, radiation equations,Rectangular Aperture, Circular Aperture.

Horn Antennas: E-Plane, H-plane Sectoral horns, Pyramidal and Conical horns.

Unit 5

Micro strip Antennas: Basic Characteristics, Feeding mechanisms, Method of analysis, Rectangular Patch, Circular Patch, Reflector Antennas: Plane reflector, parabolic reflector, Cassegrain reflectors, Introductionto MIMO.

References:

1. 1.Constantine A. Balanis, "Antenna Theory Analysis and Design", John Wiley & Sons, 4th edition, 2016.
2. 2.John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antennas for All Applications", Tata McGraw-Hill, 2002.
3. 3.R.C.Johnson and H.Jasik, "Antenna Engineering hand book", Mc-Graw Hill, 1984.
4. 4.I.J.Bhal and P.Bhartia, "Micro-strip antennas", Artech house, 1980.

CM22C: Advanced Communication Networks

Instruction Hours/week : (L-T-P-C): 3-1-0-4 Credits :4
Sessional Marks : 40 Semester-end Examination :60

Description of the Course: Basic techniques for modeling and analyzing communication networks. Fairness and utility functions, routing, congestion control, pricing, queuing models, loss networks, multi-class queues and scheduling.

Course Objectives:

1. To fairness and network utility maximization
2. To optimization based routing and congestion control
3. To basic queuing models and their application to switching and scheduling in networks.

Course Outcomes:

At the end of this course, students will be able to

1. Understand advanced concepts in Communication Networking.
2. Design and develop protocols for Communication Networks.
3. Understand the mechanisms in Quality of Service in networking.
4. Optimise the Network Design

Syllabus Contents:

Unit 1

Overview of Internet-Concepts, challenges and history. Overview of -ATM. TCP/IPCongestion and Flow Control in Internet-Throughput analysis of TCP congestion control. TCP for high bandwidth delay networks. Fairness issues in TCP.

Unit 2

Real Time Communications over Internet. Adaptive applications. Latency and throughputissues. Integrated Services Model (intServ). Resource reservation in Internet. RSVP.

Characterization of Traffic by Linearly Bounded Arrival Processes (LBAP). Leaky bucketalgorithm and its properties.

Unit 3

Packet Scheduling Algorithms-requirements and choices. Scheduling guaranteed serviceconnections. GPS, WFQ and Rate proportional algorithms. High speed scheduler design. Theory of Latency Rate servers and delay bounds in packet switched networks for LBAP traffic.

Active Queue Management - RED, WRED and Virtual clock. Control theoretic analysis of active queue management.

Unit 4

IP address lookup-challenges. Packet classification algorithms and Flow Identification-Grid of Tries, Cross producting and controlled prefix expansion algorithms.Admission control in Internet. Concept of Effective bandwidth. Measurement basedadmission control. Differentiated Services in Internet (DiffServ). DiffServ architecture and framework.

Unit 5

IPV4, IPV6, IP tunnelling, IPswitching and MPLS, Overview of IP over ATM and itsevolution to IP switching. MPLS architecture and framework. MPLS Protocols. Traffic engineering issues in MPLS.

References:

1. Jean Wairand and Pravin Varaiya, “High Performance Communications Networks”, 2nd edition, 2000.
2. Jean Le Boudec and Patrick Thiran, “Network Calculus A Theory of Deterministic Queueing Systems for the Internet”, Springer Veriag,

2001.
3. Zhang Wang, “Internet QoS”, Morgan Kaufman, 2001.
4. Anurag Kumar, D. Manjunath and Joy Kuri, “Communication Networking: An Analytical Approach” , Morgan Kaufman Publishers, 2004.
5. George Kesidis, “ATM Network Performance”, Kluwer Academic, Research Papers, 2005.

CM23C: Program Elective-III
1. Satellite Communication

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination :60**

Description of the Course: Antennas and propagation effects play a crucial role in RF systems. In practice, the design of a working system such as mobile phone networks, WiFi, RFID, Satellite communication and GPS requires a good understanding of these components. This course teaches the fundamentals of antenna and propagation and shows the application in practical examples. The course covers the theory of radiation, fundamental antenna parameters and concepts, wire antennas such as dipoles and loop antennas, antenna arrays, aperture antennas, microstrip antennas, numerical analysis, communication & radar systems and propagation effects.

Course Objectives:

1. To fairness and network utility maximization
2. To optimization based routing and congestion control
3. To basic queuing models and their application to switching and scheduling in networks.

Course Outcomes:
At the end of this course, students will be able to
1. Visualize the architecture of satellite systems as a means of high speed, high range communication system.
2. State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
3. Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

Syllabus Contents:

Unit 1:
Architecture of Satellite Communication System: Principles and architecture

of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications, and frequency bands used for satellite communication and their advantages/drawbacks.

Unit 2:
Orbital Analysis: Orbital equations, Kepler's laws of planetary motion, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc of a satellite, concepts of Solar day and Sidereal day.

Unit 3:
Satellite sub-systems: Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems, antenna sub-system.

Unit 4:
Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.

Unit 5:
Satellite link budget: Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions, Case study of Personal Communication system (satellite telephony) using LEO. Modulation and Multiple Access Schemes used in satellite communication. Typical case studies of VSAT, DBS-TV satellites and few recent communication satellites launched by NASA/ ISRO. GPS.

References:

1. Timothy Pratt and Others, "Satellite Communications", Wiley India, 2nd edition,2010.
2. S. K. Raman, "Fundamentals of Satellite Communication", PearsonEducation India, 2011.Tri T. Ha, "Digital Satellite Communications", Tata McGraw Hill, 2009.
3. Dennis Roddy, "Satellite Communication", McGraw Hill, 4th Edition, 2008.

CM23C: Program Elective-III
2. IOT and Applications
(Common to Signal processing)

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination :60**

Description of the Course: Internet of Things (IoT) cuts across different application domain verticals ranging from civilian to defense sectors. These domains include agriculture, space, healthcare, manufacturing, construction, water, and mining, which are presently transitioning their legacy infrastructure to support a lot. Today it is possible to envision pervasive connectivity, storage, and computation, which, in turn, gives rise to building different lot solutions. IoT-based applications such as innovative shopping systems, infrastructure management in both urban and rural areas, remote health monitoring and emergency notification systems, and transportation systems, are gradually relying on IoT-based systems. Therefore, it is very important to learn the fundamentals of this emerging technology.

Course Objectives:

1. To apprise students with basic knowledge of IoT that paves a platform to understand physical and logical design of IOT
2. To teach a student how to analyse requirements of various communication models and protocols for cost-effective design of IoT applications on different IoT platforms.
3. To introduce the technologies behind Internet of Things (IoT).
4. To explain the students how to code for an IoT application using Arduino/Raspberry Pi open platform.

Syllabus Contents:

UNIT I

THE INTERNET OF THINGS TODAY, TIME FOR CONVERGENCE

M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

UNIT II

COMPONENTS IN INTERNET OF THINGS

Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee,Wi-Fi, GPS, GSM Modules)

UNIT III

PROTOCOLS AND TECHNOLOGIES BEHIND IOT

IOT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, BigData Analytics, Cloud Computing, Embedded Systems.

UNIT IV

OPEN PLATFORMS AND PROGRAMMING

IOT deployment for Raspberry Pi /Arduino platform-Architecture – Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.

UNIT V

IOT APPLICATIONS

Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture

COURSE OUTCOMES:

Upon completion of the course, students will be able to

1. Explain the concept of IoT.
2. Understand the communication models and various protocols for IoT.
3. Design portable IoT using Arduino/Raspberry Pi/open platform.
4. Apply data analytics and use cloud offerings related to IoT.
5. Analyze applications of IoT in real time scenario.

TEXT BOOKS:

1. Dr. Ovidiu Vermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers, Aalborg, 2013.
2. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, CISCO Press, 2017.
3. Samuel Greengard, The Internet of Things, The MIT Press, 2015.

REFERENCES:

1. Perry Lea, “Internet of things for architects”, Packt, 2018
2. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things – Key applications and Protocols”, Wiley, 2012
3. IOT (Internet of Things) Programming: A Simple and Fast Way of

Learning, IOT Kindle Edition.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
5. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.
6. https://www.arduino.cc/https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet.

CM23C: Program Elective-III
3. RF and Microwave Circuit Design

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination :60**

Course Objectives:

1. To understand the behaviour of RF passive components model active components and Perform transmission line analysis.
2. To know the use of Smith Chart for high frequency circuit design.
3. To Justify the choice/selection of components from the design aspects and contribute in the areas of RF circuit design

Course Outcomes: At the end of this course, students will be able to

1. Understand the behaviour of RF passive components and model active components.
2. Perform transmission line analysis.
3. Demonstrate use of Smith Chart for high frequency circuit design.
4. Justify the choice/selection of components from the design aspects.
5. Contribute in the areas of RF circuit design.

Syllabus Contents:

Unit 1

Transmission Line Theory: Lumped element circuit model for transmission line, field analysis, Smith chart, quarter wave transformer, generator and load mismatch, impedance matching and tuning.

Microwave Network Analysis: Impedance and equivalent voltage and current, Impedance and admittance matrix, The scattering matrix, transmission matrix, Signal flow graph.

Unit 2

Microwave Components: Microwave resonators, Microwave filters, power dividers and directional couplers, Ferromagnetic devices and components.

Unit 3

Nonlinearity And Time Variance Inter-symbol interference, random process & noise, definition of sensitivity and dynamic range, conversion gain and distortion.

Unit 4

Microwave Semiconductor Devices and Modeling: PIN diode, Tunnel diodes, Varactor diode, Schottky diode, IMPATT and TRAPATT devices, transferred electron devices, Microwave BJTs, GaAs FETs, low noise and power GaAs FETs, MESFET, MOSFET, HEMT.

Unit 5

Amplifiers Design: Power gain equations, stability, impedance matching, constant gain and noise figure circles, small signal, low noise, high power and broadband amplifier, oscillators, Mixers design.

References:

1. Matthew M. Radmanesh, "Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design", AuthorHouse, 2009.
2. D.M.Pozar, " Microwave engineering" ,Wiley, 4th edition, 2011.
3. R.Ludwig and P.Bretchko, "R. F. Circuit Design", Pearson Education Inc, 2009.
4. G.D. Vendelin, A.M. Pavoi, U. L. Rohde, "Microwave Circuit Design Using Linear And Non Linear Techniques", John Wiley 1990.
5. S.Y. Liao, "Microwave circuit Analysis and Amplifier Design", Prentice Hall 1987. Radmanesh, "RF and Microwave Electronics Illustrated" , Pearson Education, 2004.W.H.Freeman & Co, 1978

CM23C: Program Elective-III
4. MIMO Systems

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination :60**

Course Objectives:

1. To understand channel modelling and propagation, MIMO Capacity, space-time coding MIMO receivers, MIMO for multi-carrier
2. systems (e.g. MIMO-OFDM), multi-user communications, multi-user MIMO.
3. To gain knowledge understand cooperative and coordinated multi-cell MIMO, introduction to MIMO in 4G (LTE, LTE-Advanced, WiMAX).
4. To perform Mathematical modelling and analysis of MIMO systems. To build a small low-cost embedded system using Arduino / Raspberry Pi or

equivalent boards.

Course Outcomes:

At the end of this course, students will be able to

1. Understand channel modelling and propagation, MIMO Capacity, space-time coding.
2. MIMO receivers, MIMO for multi-carrier systems (e.g. MIMO-OFDM), multi-user communications, multi-user MIMO.
3. Understand cooperative and coordinated multi-cell MIMO, introduction to MIMO in 4G (LTE, LTE-Advanced, WiMAX).
4. Perform Mathematical modelling and analysis of MIMO systems.

Syllabus Contents:

Unit 1:

Introduction to Multi-antenna Systems, Motivation, Types of multi-antenna systems,MIMO vs. multi-antenna systems.Diversity, Exploiting multipath diversity, Transmit diversity, Space-time codes, TheAlamouti scheme, Delay diversity, Cyclic delay diversity, Space-frequency codes, Receive diversity, The rake receiver, Combining techniques, Spatial Multiplexing, Spectral efficiency and capacity, Transmitting independent streams in parallel, Mathematical notation

Unit 2:

The generic MIMO problem, Singular Value Decomposition, Eigenvalues andeigenvectors, Equalising MIMO systems, Disadvantages of equalising MIMO systems, Pre-distortion in MIMO systems, Disadvantages of pre-distortion in MIMO systems, Pre-coding and combining in MIMO systems, Advantages of pre-coding and combining, Disadvantages of pre-coding and combining, Channel state information.

Unit 3

Codebooks for MIMO, Beamforming, Beamforming principles, Increased spectrumefficiency, Interference cancellation, Switched beamformer, Adaptive beamformer, Narrowband beamformer, Wideband beamformer

Unit 4:

Case study: MIMO in LTE, Codewords to layers mapping, Pre-coding for spatialmultiplexing, Pre-coding for transmit diversity, Beamforming in LTE, Cyclic delay diversity based pre-coding, Pre-coding codebooks, Propagation Channels, Time & frequency channel dispersion, AWGN and multipath propagation channels, Delay spread values and time variations, Fast and slow fading environments, Complex baseband multipath channels, Narrowband and wideband channels, MIMO channel models

Unit 5:
Channel Estimation, Channel estimation techniques, Estimation and tracking, Trainingbased channel estimation, Blind channel estimation, Channel estimation architectures, Iterative channel estimation, MMSE channel estimation, Correlative channel sounding, Channel estimation in single carrier systems, Channel estimation for CDMA, Channel estimation for OFDM.

References:

1. Claude Oestges, Bruno Clerckx, "MIMO Wireless Communications : From Real-world Propagation to Space-time Code Design",Academic Press, 1st edition, 2010.
2. Mohinder Janakiraman, "Space - Time Codes and MIMO Systems", Artech House Publishers, 2004.

CM24C: Program Elective-IV
1. Random Processes and Queuing Models
(Common to Signal Processing)

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination :60**

Prerequisites: Probability Theory and Stochastic Processes

Preamble: This course is designed to provide necessary basic concepts in random processes which are widely applied in random signals, linear systems in communication engineering and IT fields. The objective of this course is to familiarize the understanding of stochastic processes and queuing models. The syllabus also covers the concepts of Markovian and advanced queueing models which are essential to design and analyze communication networks.

Course Learning Objectives: The objectives of this course is to enable the student to

1. Characterize stochastic processes with an emphasis on stationary random processes.
2. Use the properties of random processes with LTI systems in real world situations.
3. Understand Markov chains and their transient behavior.
4. Differentiate between different models of queuing theory and their performance measures.
5. Understand network of queues with Poisson external arrivals, exponential service requirements and independent routing.

Course Outcomes:

At the end of the course, the students will be able to

1. Analyze the various classifications of Random Processes and characterize phenomena which evolve with respect to time in a probabilistic manner.
2. Apply the ideas of Random Processes to the LTI Systems for Spectral analysis.
3. Understand Markov Chains and regenerative processes used in modeling a wide variety of systems.
4. Understand the basic characteristic features of a queuing system and acquire skills in analyzing queuing models.
5. Analyze the performance of the queuing networks.

UNIT I

REVIEW OF RANDOM PROCESSES: Classification of General Random Processes, Binomial Processes, Poisson Processes, Ergodic Process, Gaussian Random Processes, Stationary and Wide Sense Stationary Random Processes, Random walks and gambler's ruin, Processes with independent increments and martingales, Brownian motion, Counting processes and the Poisson process, Stationarity, Joint properties of random processes.

UNIT II

RANDOM PROCESSES IN LINEAR SYSTEMS AND SPECTRAL ANALYSIS: Basic definitions, Spectral Density Function, transfer functions and power spectral densities, Discrete-time processes in linear systems, Low Pass and Band Pass Processes, Baseband random processes, Narrowband random processes.

UNIT III

MARKOV PROCESSES: Markov Chains, Probability Distribution of a Markov Chain, Transition Probability Matrices of a Markov Chain, Classification of States and Chains, Chapman-Kolmogorov Theorem, Stationary Distribution for a Markov Chains, Classification of States of a Markov Chain, Birth and Death Processes, Renewal Process, The Transition Probability Function, Limiting Probabilities, Exponential Distribution & Poison Process.

UNIT IV

QUEUING THEORY: Basic Characteristics of Queueing Models, Introduction to Markovian queueing models, Steady state distribution, Little's Theorem, Cost equations, steady state probabilities, Queuing Models: **(M/M/1) : (∞/FIFO)** Single server with infinite system capacity, **(M/M/1) : (k/FIFO)**

Single Server with Finite Capacity, **(M/M/s) : (∞/FIFO)** Multiple Server with Infinite Capacity, **(M/M/s) : (k/FIFO)** Multiple Server with Finite Capacity, models balance equations, Erlang's B and C formulae, M/G/1 Queuing system characteristics, Queues with finite waiting rooms – Queues with impatient customers: Balking and reneging.

Unit V

QUEUEING NETWORKS: Network of queues basic concepts, Tandem Queues, Channels in Series or Jackson Networks, Queues in series with multiple channels at each phase, Closed Jackson Networks, Approximating Closed Networks, Open Networks with General Customer Routes, Symmetric Queues.

Text Books:

1. Sheldon M. Ross, Introduction to Probability Models, 10th Edition, Elsevier, 2010.
2. T Veera Rajan , Probability, Statistics and Random Process, 3rd Edition, Tata Mc Graw Hill, 2008.
3. R. D. Yates and D. J. Goodman, "Probability and Stochastic Processes: A Friendly Introduction for Electrical and Computer Engineers", 3rd Edition International Student Version, Wiley, 2014.

Reference Books:

1. J.F. Shortle, J.M. Thompson, D. Gross and C.M. Harris, Fundamentals of Queueing Theory, 5th Edition, Wiley, 2018.
2. J. Medhi, Stochastic Models in Queueing Theory, 2nd Edition, Academic Press, 2003.
3. U.N. Bhat, An Introduction to Queueing Theory, Springer, 2015.

CM24C: Program Elective-IV
2. Pattern Recognition and Machine Learning
(Common to Signal Processing)

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination :60**

Course Objectives:

1. To study the parametric and linear models for classification and design neural network and SVM for classification
2. To develop machine independent and unsupervised learning techniques.

Course Outcomes:

At the end of this course, students will be able to

1. Study the parametric and linear models for classification
2. Design neural network and SVM for classification

3. Develop machine independent and unsupervised learning techniques.

Syllabus Contents:

Unit 1

Introduction to Pattern Recognition: Problems, applications, design cycle, learning andadaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes rule, discriminant functions, loss functions and Bayesian error analysis

Unit 2

Linear models: Linear Models for Regression, linear regression, logistic regression LinearModels for Classification

Unit 3

Neural Network: perceptron, multi-layer perceptron, back propagation algorithm, error surfaces,practical techniques for improving back propagation, additional networks and training methods, Adaboost, Deep Learning

Unit 4

Linear discriminant functions - decision surfaces, two-category, multi-category, minimum-squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine

Unit 5

Algorithm independent machine learning – lack of inherent superiority of any classifier, biasand variance, re-sampling for classifier design, combining classifiers

Unsupervised learning and clustering – k-means clustering, fuzzy k-means clustering,hierarchical clustering

References:

1. 1.Richard O. Duda, Peter E. Hart, David G. Stork, “Pattern Classification”, 2nd Edition John
2. Wiley & Sons, 2001.
3. 2.Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, “The Elements of Statistical
4. Learning”, 2nd Edition, Springer, 2009.
5. 3.C. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.

CM24C: Program Elective-IV
3. Programmable Networks - SDN, NFV

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination :60**

Course Objectives:

1. To understand advanced concepts in Programmable Networks, Software Defined Networking, an emerging Internet architectural framework.
2. To know the main concepts, architectures, algorithms, protocols and applications in SDN and NFV.

Course Outcomes:

At the end of this course, students will be able to

1. Understand advanced concepts in Programmable Networks.
2. Understand Software Defined Networking, an emerging Internet architectural framework.
3. Implement the main concepts, architectures, algorithms, protocols and applications in SDN and NFV.

Syllabus Contents:

Unit 1

Introduction to Programmable Networks, History and Evolution of Software Defined Networking (SDN), Fundamental Characteristics of SDN, Separation of Control Plane and Data Plane, Active Networking.

Unit 2

Control and Data Plane Separation: Concepts, Advantages and Disadvantages, the basics of Open Flow protocol.

Network Virtualization: Concepts, Applications, Existing Network Virtualization Framework, Mininet A simulation environment for SDN.

Unit 3

Control Plane: Overview, Existing SDN Controllers including Floodlight and Open Day light projects. Customization of Control Plane: Switching and Firewall Implementation using SDN Concepts. Data Plane: Software-based and Hadrware-based; Programmable Network Hardware.

Unit 4

Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs. Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications.

Unit 5

Data Center Networks: Packet, Optical and Wireless Architectures, Network Topologies. Use Cases of SDNs: Data Centers, Internet Exchange Points, Backbone Networks, Home Networks, Traffic Engineering.

References:

1. Thomas D. Nadeau, Ken Gray, "SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies", O'Reilly Media, August 2013.
2. Paul Goransson, Chuck Black, Timothy Culver. "Software Defined Networks: A Comprehensive Approach", Morgan Kaufmann Publishers, 2016.
3. Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", CRC Press, 2014.
4. Vivek Tiwari, "SDN and OpenFlow for Beginners", Amazon Digital Services, Inc., ASIN: ,2013.
5. Nick Feamster, Jennifer Rexford and Ellen Zegura, "The Road to SDN: An Intellectual History of Programmable Networks" ACM CCR April 204.
6. Open Networking Foundation (ONF) Documents, https://www.opennetworking.org,2015.http://www.openflow.org,

CM24C: Program Elective-IV
4. Remote Sensing
(Common to Signal Processing)

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination :60**

Course Objectives:

1. To understand basic concepts, principles and applications of remote sensing, particularly the geometric and radiometric principles
2. To know the applications of principles to a variety of topics in remote sensing, particularly related to data collection, radiation, resolution, and sampling.

Course Outcomes:

At the end of this course, students shall be able to

1. Understand basic concepts, principles and applications of remote sensing, particularly the geometric and radiometric principles
2. Provide examples of applications of principles to a variety of topics in remote sensing, particularly related to data collection, radiation, resolution, and sampling.

Syllabus Contents:

Unit 1

Physics Of Remote Sensing: Electro Magnetic Spectrum, Physics of Remote Sensing-Effects of Atmosphere-Scattering–Different types–Absorption-Atmospheric window-Energy interaction with surface features –Spectral reflectance of vegetation, soil and water atmospheric influence on spectral response patterns-multi concept in Remote sensing.

Data Acquisition: Types of Platforms–different types of aircrafts-Manned and Unmanned space crafts–sun synchronous and geo synchronous satellites – Types and characteristics of different platforms –LANDSAT, SPOT, IRS, INSAT, IKONOS, QUICKBIRDetc.

Unit 2

Photographic products, B/W,color, color IR film and their characteristics – resolving power of lens and film - Optomechanical electro optical sensors – across track and along track scanners-multispectral scanners and thermal scanners–geometric characteristics of scanner imagery - calibration of thermal scanners.

Unit 3

Scattering System: Microwave scatterometry, types of RADAR –SLAR – resolution –range and azimuth –real aperture and synthetic aperture RADAR. Characteristics of Microwave images topographic effect-different types of Remote Sensing platforms –airborne and space borne sensors -ERS, JERS, RADARSAT, RISAT -Scatterometer, Altimeter-LiDAR remote sensing, principles, applications.

Unit 4

Thermal And Hyper Spectral Remote Sensing: Sensors characteristics-principle of spectroscopy-imaging spectroscopy–field conditions, compound spectral curve, Spectral library, radiative models, processing procedures, derivative spectrometry, thermal remote sensing –thermal sensors, principles, thermal data processing, applications.

Unit 5

Data Analysis: Resolution–Spatial, Spectral, Radiometric and temporal resolution-signal to noise ratio-data products and their characteristics-visual and digital interpretation–Basic principles of data processing – Radiometric correction–Image enhancement–Image classification–Principles of LiDAR, Aerial Laser Terrain Mapping.

References:

1. 1.Lillesand.T.M. and Kiefer.R.W,"Remote Sensing and Image interpretation", 6thEdition, John Wiley & Sons, 2000.
2. 2.John R. Jensen, "Introductory Digital Image Processing: A Remote Sensing Perspective", 2nd Edition, Prentice Hall,1995.
3. 3.Richards, John A., Jia, Xiuping, "Remote Sensing Digital Image Analysis", 5th Edition, Springer-Verlag Berlin Heidelberg, 2013.
4. 4.Paul Curran P.J. Principles of Remote Sensing, 1st Edition, Longman Publishing Group, 1984.
5. 5.Charles Elachi, Jakob J. van Zyl, "Introduction to The Physicsand Techniques of Remote Sensing", 2nd Edition, Wiley Serie, 2006.
6. 6.Sabins, F.F.Jr, "Remote Sensing Principles and Image Interpretation", 3rd Edition, W.H.Freeman& Co, 1978

CM25L: Antennas and Radiating Systems Lab

Instruction Hours/week : 3(P) **Credits : 1.5**
Sessional Marks : 40 **Semester-end Examination :60**

Course Objectives:

1. To determine specifications, design, construct and test antenna.
2. To explore and use tools for designing, analyzing and testing antennas. These tools include Antenna design and analysis software, network analyzers, spectrum analyzers, and antenna pattern measurement techniques.

Course Outcomes:

At the end of this course, students will be able to

1. Determine specifications, design, construct and test antenna.
2. Explore and use tools for designing, analyzing and testing antennas. These tools include Antenna design and analysis software, network analyzers, spectrum analyzers, and antenna pattern measurement techniques.

List of Assignments:

1. Simulation of half wave dipole antenna.
2. Simulation of change of the radius and length of dipole wire on frequency of resonance of antenna.
3. Simulation of quarter wave, full wave antenna and comparison of their parameters.
4. Simulation of monopole antenna with and without ground plane.
5. Study the effect of the height of the monopole antenna on the radiation characteristics of the antenna.

6. Simulation of a half wave dipole antenna array.
7. Study the effect of change in distance between elements of array on radiation pattern of dipole array.
8. Study the effect of the variation of phase difference 'beta' between the elements of the array on the radiation pattern of the dipole array.
9. Case study.

CM26L: Advanced Communication Networks Lab

Instruction Hours/week : 3(P) **Credits : 1.5**
Sessional Marks : 40 **Semester-end Examination :60**

Course Objectives:

1. To identify the different types of network devices and their functions within a network.
2. To understand the skills of sub-netting and routing mechanisms, basic protocols of computer networks, and how they can be used to assist in network design and implementation.

Course Outcomes:

At the end of this course, students will be able to

1. Identify the different types of network devices and their functions within a network.
2. Understand and build the skills of sub-netting and routing mechanisms.
3. Understand basic protocols of computer networks, and how they can be used to assist in network design and implementation.

List of Assignments:

1. Study of Networking Commands (Ping, Tracert, TELNET, nslookup, netstat, ARP, RARP) and Network Configuration Files.
2. Linux Network Configuration.
   a. Configuring NIC's IP Address.
   b. Determining IP Address and MAC Address using if-config command.
   c. Changing IP Address using if-config.
   d. Static IP Address and Configuration by Editing.
   e. Determining IP Address using DHCP.
   f. Configuring Hostname in /etc/hosts file.
3. Design TCP iterative Client and Server application to reverse the given input sentence.
4. Design a TCP concurrent Server to convert a given text into upper case using multiplexing system call "select".
5. Design UDP Client Server to transfer a file.
6. Configure a DHCP Server to serve contiguous IP addresses to a pool of

four IP devices with a default gateway and a default DNS address. Integrate the DHCP server with a BOOTP demon to automatically serve Windows and Linux OS Binaries based on client MAC address.

   a. Configure DNS: Make a caching DNS client, and a DNS Proxy; implement reverse DNS and forward DNS, using TCP dump/Wireshark characterise traffic when the DNS server is up and when it is down.

7. Configure a mail server for IMAP/POP protocols and write a simple SMTP client in C/C++/Java client to send and receive mails.
8. Configure FTP Server on a Linux/Windows machine using a FTP client/SFTP client characterise file transfer rate for a cluster of small files 100k each and a video file of 700mb.Use a TFTP client and repeat the experiment.
9. Signaling and QoS of labeled paths using RSVP in MPLS.
10. Find shortest paths through provider network for RSVP and BGP.
11. Understand configuration, forwarding tables, and debugging of MPLS.

CM27C:Cyber Security

Course Type:	**Value Added**	**Semester:**	**II Sem**	**Credits :**	**3**
Course Code:	**CM27C**	**Theory :**	**2 Hrs/ Week**	**Practical :**	**2Hrs/ Week**
		Assessment:	**Lab reports and written exams**	**Internal Continuous Assessment:**	**100 M**

Course Overview / Description: Cyber security is perhaps the most important topic in today environment. Demand for cyber security professionals has exploded, in the private and public sectors alike. Student can learn how to defend information systems from cyber attacks, how to recover compromised systems, how to architect secure systems and so much more. This course is focuses on the models, tools, and techniques for enforcement of security with some emphasis on the use of cryptography. Students will learn security from multiple perspectives.

Course Learning Objectives:

1. To prepare students with the technical knowledge and skills needed to protect and defend computer systems and networks from cyber security attacks.
2. To develop graduates that can plan, implement, and monitor cyber security mechanisms to help ensure the protection of information

technology assets.
3. To develop graduates that can identify, analyze, and remediate computer security breaches.

Course Outcomes: After completing this course student will be:

1. Be able to understand the basic terminologies related to cyber security and current cyber security threat landscape. They will also develop understanding about the Cyber warfare and necessity to strengthen the cyber security of end user machine, critical IT and national critical infrastructure.
2. Have complete understanding of the cyber attacks that target computers, mobiles and persons. They will also develop understanding about the type and nature of cyber crimes and as to how report these crimes through the prescribed legal and Government channels.
3. Be able to understand the legal framework that exist in India for cyber crimes and penalties and punishments for such crimes, It will also expose students to limitations of existing IT Act, 2000 legal framework that is followed in other countries and legal and ethical aspects related to new technologies.
4. Understand the aspects related to personal data privacy and security. They will also get insight into the Data Protection Bill, 2019 and data privacy and security issues related to Social media platforms.
5. Understand the main components of cyber security plan. They will also get insights into risk-based assessment, requirement of security controls and need for cyber security audit and compliance.

Unit- I Overview of Cyber security

Cyber security increasing threat landscape, Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker., Non-state actors, Cyber terrorism, Protection of end user machine, Critical IT and National Critical Infrastructure, Cyber warfare, Case Studies.

Unit-II Cyber Crimes

Cyber crimes targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach., Online scams and frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Online sextortion, Debit/ credit card fraud, Online payment fraud, Cyber bullying, website defacement, Cyber squatting, Pharming, Cyber espionage, Cryptojacking, Darknet- illegal trades, drug trafficking, human trafficking., Social Media Scams & Frauds- impersonation, identity theft, job scams, misinformation, fake news cyber crime against persons - cyber grooming, child pornography, cyber stalking., Social Engineering attacks, Cyber Police stations, Crime reporting procedure, Case studies.

Unit-III Cyber Law

Cyber crime and legal landscape around the world, IT Act, 2000 and its amendments, Limitations of IT Act, 2000,Cyber crime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies-

AI/ML, IoT, Blockchain, Darknet and Social media, Cyber Laws of other countries, Case Studies.

Unit-IV Data Privacy and Data Security

Defining data, meta-data, big data, non-personal data. Data protection, Data privacy and data security, Personal Data Protection Bill and its compliance, Data protection principles, Big data security issues and challenges, Data protection regulations of other countries- General Data Protection Regulations(GDPR), 2016 Personal Information Protection and Electronic Documents Act (PIPEDA), Social media- data privacy and security issues.

Unit-V Cyber security Management, Compliance and Governance:

Cyber security Plan- cyber security policy, cyber crises management plan, Business continuity, Risk assessment, Types of security controls and their goals, Cyber security audit and compliance, National cyber security policy and strategy.

Practical Work

The practical list has been suggested for the applicable modules; however, the faculty may expand the list as per the syllabus content duly taking into consideration the emerging nature of cyber threats and incumbent protective measures to guard against such threats.

Practical list of Experiments:

1. Platforms for reporting cyber crimes.
2. Checklist for reporting cyber crimes online.
3. Setting privacy settings on social media platforms.
4. Do's and Don'ts for posting content on Social media platforms.
5. Registering complaints on a Social media platform.
6. Prepare password policy for computer and mobile device.
7. List out security controls for computer and implement technical security controls in the personal computer.
8. List out security controls for mobile phone and implement technical security controls in the personal mobile phone.
9. Log into computer system as an administrator and check the security policies in the system.

Text Books/ References:

1. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.
2. Information Warfare and Security by Dorothy F. Denning, Addison Wesley.
3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform.
4. Data Privacy Principles and Practice by Natraj Venkataramanan and Ashwin Shriram, CRC Press.

5. Information Security Governance, Guidance for Information Security Managers by W. KragBrothy, 1st Edition, Wiley Publication.
6. Auditing IT Infrastructures for Compliance By Martin Weiss, Michael G. Solomon, 2nd Edition, Jones Bartlett Learning.

CM28M:Mini Project With Seminar

Instruction Hours/week : 4(P) **Credits : 2**
Sessional Marks : 100 **Semester-end Examination :-**

Course Outcomes:

At the end of this course, students will be able to

1. Understand of contemporary / emerging technology for various processes and systems.
2. Share knowledge effectively in oral and written form and formulate documents.

Syllabus Contents:

The students are required to search / gather the material / information on a specific a topic comprehend it and present / discuss in the class.

Semester III & IV
(Dissertation) Dissertation Phase – I, Phase – II and Viva-Voce

Instruction Hours/week : 24+20(P) **Credits : 12+16**
Sessional Marks : 40+40 **Semester-end Examination : 60+60**

Course Outcomes:

At the end of this course, students will be able to

1. Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
2. Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
3. Ability to present the findings of their technical solution in a written report.
4. Presenting the work in International/ National conference or reputed journals.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the

following

- Relevance to social needs of society
- Relevance to value addition to existing facilities in the institute
- Relevance to industry need
- Problems of national importance
- Research and development in various domain

The student should complete the following:

- Literature survey Problem Definition
- Motivation for study and Objectives
- Preliminary design / feasibility / modular approaches
- Implementation and Verification
- Report and presentation

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

- Experimental verification / Proof of concept.
- Design, fabrication, testing of Communication System.
- The viva-voce examination will be based on the above report and work.

Guidelines for Dissertation Phase – I and II at M. Tech. (Electronics):

- As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.
- The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.
- After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.
- Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.
- Phase – I deliverables: A document report comprising of summary of

literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.

- Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.
- During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.
- Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, a record of continuous progress.
- Phase – II evaluation: Guide along with appointed external examiner shall assess the
- progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work.

******

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING:

TIRUPATI-517502

R-23– Scheme of Instructions effective from the academic year 2023 – 2024

Programme Scheme

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING (AUTONOMOUS)

SRI VENKATESWARA UNIVERSITY

TIRUPATI-517502 (A.P), INDIA.

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502
Department of Electronics and Communication Engineering-Scheme of Instruction- (CBCS) effective from the Academic Year 2023-2024

M.Tech (PG) (Electronics and Communication Engineering)
Specialization: Signal Processing (SP)

I Semester

S.No.	Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
				Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
1	PCC	SP11C	Advanced Digital Signal Processing (Common to Communication systems CM11C)	3	1	0	4	4	40	60	100
2	PCC	SP12C	Digital Image and Video Processing	3	1	0	4	4	40	60	100
3	PCC	SP13C	DSP Architecture (Common to Communication systems CM12C)	3	1	0	4	4	40	60	100
4	PEC	SP14C	Programme Elective- I	3	0	0	3	3	40	60	100
5	PEC	SP15C	Programme Elective- II	3	0	0	3	3	40	60	100
6	PCC	SP16L	Advanced Digital Signal Processing Lab (Common to Communication systems CM16L)	0	0	3	3	1.5	40	60	100
7	PCC	SP17L	Digital image and Video Processing Lab	0	0	3	3	1.5	40	60	100
8	MAC	SP18C	Research Methodology and IPR	3	0	0	3	3	40	60	100
Total				18	3	6	27	24	320	480	800

List of Programme Elective Course I (SP14C)	List of Programme Elective Course II (SP15C)
1. Computer Vision	1. Joint time Frequency Analysis and Multi Resolution Analysis
2. Artificial Intelligence	2. Voice and Data Networks (Common to Communication systems CM15C)
3. Wireless Sensor Networks (Common to Communication systems CM14C)	3. Audio Video Coding and Compression
4. Optimization Techniques.	4. Modeling and simulation techniques

II Semester

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	SP21C	Pattern recognition and Machine Learning (Common to Communication systems CM24C)	3	1	0	4	4	40	60	100
PCC	SP22C	Detection and Estimation Theory	3	1	0	4	4	40	60	100
PEC	SP23C	Programme Elective Course - III	3	0	0	3	3	40	60	100
PEC	SP24C	Programme Elective Course - IV	3	0	0	3	3	40	60	100
PCC	SP25L	Pattern recognition and Machine Learning Lab	0	0	3	3	1.5	40	60	100
PCC	SP26L	Detection and Estimation Theory Lab	0	0	3	3	1.5	40	60	100
VAC	SP27C	Cyber Security	2	0	2	4	3	100	-	100
PCC	SP28M	Mini Project with Seminar	0	0	4	4	2	100	-	100
	Total		**14**	**2**	**12**	**28**	**22**	**440**	**360**	**800**

List of Programme Elective Courses III(SP23C)	List of Programme Elective Courses III (SP24C)
1. Advanced Computer Architecture	1. Random processes and Queueing models (Common to Communication systems CM24C)
2. IoT and Applications (Common to Communication systems CM23C)	2. Multispectral signal analysis
3. Digital design and verification	3. Biomedical signal Processing
4. Audio Processing	4. Remote Sensing (Common to Communication systems CM24C)

III Semester

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
OEC	SP31C	Open Elective Course (Through MOOCS)	0	0	0	0	3	100	-	100
PCC	SP32I	Industrial/ Research Internship (Min of 4 Weeks)	0	0	0	0	3	100	-	100
PCC	SP33D	Dissertation Work Phase-I	0	0	24	24	12	40	60	100
	Total		**0**	**0**	**20**	**20**	**18**	**240**	**60**	**300**

IV Semester

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	SP41D	Dissertation Work Phase-II and Viva-Voce	0	0	20	20	10 + 06 = 16	40	60	100
	Total		**0**	**0**	**20**	**20**	**16**	**40**	**60**	**100**

M. Tech.(Electronics and Communication Engineering)
Curriculum Structure
Specialization: Signal processing

Vision of The Institute

The Vision of Sri Venkateswara University College of Engineering is to be the leader in the creation and development of globally competitive human capital in Engineering Education for Technological, Economical and Social Enrichment of the Society, through its open and flexible Academic Programs.

Mission of The Institute

1. To be recognized as a premier institution offering Engineering Education programs, training human resources oriented to problem solving and system development.
2. To carry out research in Engineering and Technology relevant to all segments of society.
3. To assume leadership in sustainable technological growth of the Indian society.
4. To be a natural destination for excellence and diversity in thought and practice.

Department of Electronics &Communication Engineering

Vision

To be a lead department imparting quality and value embedded higher education and research emphasizing freedom of learning andpractice.

Mission

1. Transforming students into full-fledged professionals and to become leaders in dynamic global environment.
2. Augmenting knowledge and technologies in rapidly advancing fields of Electronics and Communication Engineering.
3. Promoting in depth research and create Centre of excellence in thrust areas.

Program Outcomes (POs) for PG programs

POs are statements that describe what students are expected to know and

be able to do upon graduating from the program. These relate to the skills, knowledge, analytical ability attitude and behaviour that students acquire through the program.
The POs essentially indicate what the students can do from subject-wise knowledge acquired by them during the program. As such, POs define the professional profile of a graduate of PG Engineering Program.

NBA has defined the following three POs for a graduate of PG Engineering Program:

1. **PO1**: An ability to independently carry out research/investigation and development work to solve practical problems.
2. **PO2**: An ability to write and present a substantial technical report/document.
3. **PO3**: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

Program Specific Outcomes (PSOs):

M. Tech. in Signal Processing graduates will be able to:

1. **PSO 1**. Integrate knowledge to identify, formulate, solve complex problems and apply in Signal Processing, Machine Vision and Communication Networks.
2. **PSO 2.** Use the concepts and software tools of signal processing to design the systems to meet the specific needs within economic, social and environmental constraints.

Program Educational Objectives (PEOs):

M. Tech. in Signal Processing Program, graduates will be able to:

1. **PEO 1.**Providetechnical competency to identify, analyze and solve engineering problems pertaining to design, development, and deployment of signal processing systems.
2. **PEO 2.**Possess suitable knowledge for analyzing, modelling, and evaluating the research problems in signal processing to pursue research and enhance the employability.
3. **PEO 3.**Inculcate professionalism, ethical attitude, communication skills, social values and ability to relate engineering solutions to real life and practical applications.

SP11C Advanced Digital Signal Processing
(Common to Communication Systems)

Instruction Hours/week : (L-T-P-C): 3-1-0-4 **Credits : 4**

Sessional Marks : 40 **Semester-End Examination: 60**

Course Description: This course will provide rigorous foundations in Digital filter structures, Multirate signal processing, Linear prediction, Adaptive filters and Spectral estimation. This course emphasizes the use of digital signal processing techniques for designing digital systems used in Communications, Control, Media Applications etc.

Prerequisites: Signals and Systems, Digital Signal Processing.

Course Objectives: To enable the student to

1. Understand to develop FIR & IIR filter structures depending upon the given applications.
2. Understand theory of Multirate DSP, solve numerical problems and write algorithms.
3. Understand theory of prediction and solution of normal equations.
4. Understand the different types of adaptive filters used in signal processing applications.
5. Discuss different methods of spectrum estimation and analysis.

Course Outcomes: After completion of the course, student will be able to

1. Learn and implement the digital filters to computational complexity problems.
2. Analyze multirate DSP systems and Design a decimator and integrator including multi-stages.
3. Apply theory of prediction and find solution of normal equations
4. Design different types of filters such as Adaptive filters, poly phase filters, Wiener filters, ARMA lattice-ladder filters, etc.
5. Estimate the power spectrum by using different methods.

Contents:

Unit 1

Digital filter structures: Basic FIR/IIR filter structures, FIR/IIR Cascaded lattice structures, Parallel structures, all pass realization of IIR transfer functions, Sine- cosine generator, Computational complexity of filter structures.

Unit 2

Multirate Digital Signal Processing: Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase

filters, Quadrature mirror filter (QMF) banks, Conditions for perfect reconstruction, digital filter banks, Applications in sub-band coding.

Unit 3

Linear Prediction and Optimum Linear Filters: Innovations Representation of a Stationary Random Process, Forward and Backward linear prediction, Solution of the Normal Equations, Properties of linear prediction-Error Filter, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.

Unit 4

Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, The Least-Mean-Square (LMS) algorithm, Normalized LMS (NLMS), The Leaky LMS, Recursive Least Square (RLS) algorithm.

Unit 5

Power Spectral Estimation: Estimation of Spectra from Finite Duration Observations of a Signal, Periodogram, Use DFT in power Spectral Estimation, Bartlett, Welch and Blackman, Tukey methods, Comparison of performance of Non-Parametric Power Spectrum Estimation Methods.

Parametric Methods of Power Spectrum Estimation: Relationship between Auto-Correlation and Model Parameters, Yule-Walker, Burg and Unconstructrained Least Squares Methods, Moving Average (MA) and ARMA Models Minimum Variance Method, Eigen analysis Algorithms for Spectrum Estimation.

Text Books:

1. **John G. Proakis** and**Dimitris G. Manolakis,** Digital Signal Processing: Principles, Algorithms and Applications, 5th Edition, **ISBN-13: 9780137348657,** Published by Pearson, 2021.
2. John G. Proakis, Digital Signal Processing Principles, Algorithms, and Applications, Prentice Hall International Inc, 4th Edition, 2012.
3. Sanjit Kumar Mitra, Digital Signal Processing- A Computer Based Approach, 4th edition, McGraw Hill Education, 2011.
4. D.G. Manolakis, V.K. Ingle and S.M.Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.

References:

1. N. J. FliegMultirate Digital Signal Processing: Multirate Systems - Filter Banks – Wavelets,1st Edition, John Wiley and Sons Ltd, 1999.
2. Sanjit Kumar Mitra, and Yonghong Kuo. Digital Signal Processing: A Computer-Based Approach, 4 th. Edition McGraw-Hill Higher Education, New York, 2013.
3. M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John

Wiley & Sons Inc., 2002.
4. Simon Haykin, "Adaptive Filter Theory", 4th Edition, Prentice Hall, 2001.

SP12C Digital Image and Video Processing

Instruction Hours/week : (L-T-P-C): 3-1-0-4 **Credits : 4**

Sessional Marks : 40 **Semester-End Examination: 60**

Course Description:n this course you will learn the basic principles and tools used to process images and videos, and how to apply them in solving practical problems. Digital images and videos are everywhere these days – in thousands of scientific, consumer, industrial, and creative applications. Which are obtained from a wide range of the electromagnetic spectrum - from visible light and infrared to gamma rays and beyond. The ability to process image and video signals is therefore an incredibly important skill to master for engineering/science students, software developers, and practicing scientists. Digital image and video processing continues to enable the multimedia technology revolution we are experiencing today. This course will strengthen fundamental knowledge about digital image and video processing techniques along with mathematical framework to describe and analyze images and videos. Digital image and video processing is used in almost all engineering fields and wide range of applications in industrial automation, medical, agriculture, security, entertainment, education and many more.

Course Objectives: The student should be made to:

1. To know the concept of image fundamentals and mathematical transforms necessary for image Processing
2. To study the image enhancement and segmentation techniques
3. To learn about different color models and image compression procedures
4. To understand fundamentals of Video Coding

Course Outcomes:

At the end of this course, students will be able to

1. Learn different techniques for image enhancement, video and image recovery
2. Understand techniques for image and video segmentation
3. Study techniques for image and video compression and object recognition

Syllabus Contents:

Unit 1

Digital Image and Video Fundamentals: Digital image and video fundamentals and formats, 2-D and 3-D sampling and aliasing, 2-D/3-D filtering, image decimation/interpolation, video sampling and interpolation, Basic image processing operations, Image Transforms,Need for image

transforms, DFT, DCT, Walsh, Hadamard transform, Haar transform, Wavelet transform

Unit 2

Image and Video Enhancement and Restoration: Histogram, Point processing, filtering, image restoration, algorithms for 2-D motion estimation, change detection, motion-compensated filtering, frame rate conversion, deinterlacing, video resolution enhancement, Image and Video restoration (recovery).

Colour image Processing: Colour fundamentals, Colour models, Conversion of colour models, Pseudo colour image processing, Full colour processing

Unit 3

Image and Video Segmentation: Discontinuity based segmentation- Line detection, edge detection, thresholding, Region based segmentation, Scene Change Detection, Spatiotemporal Change Detection, Motion Segmentation, Simultaneous Motion Estimation and Segmentation Semantic Video Object Segmentation, Morphological image processing.

Unit 4

Image and Video Compression: Lossless image compression including entropy coding, lossy image compression, video compression techniques, and international standards for image and video compression (JPEG, JPEG 2000, MPEG-2/4, H.264, SVC), Video Quality Assessment

Unit 5

Object recognition: Image Feature representation and description-boundary representation, boundary descriptors, regional descriptors, feature selection techniques, introduction to classification, supervised and unsupervised learning, Template matching, Bayes classifier

References:

1. Ed. Al Bovik ,"Handbook of Image and Video Processing", 2nd Edition, Academic Press,2000.
2. J. W. Woods, "Multidimensional Signal, Image and Video Processing and Coding", 2nd Edition, Academic Press, 2011.
3. Rafael C. Gonzalez and Richard E. Woods," Digital Image Processing", 3rd Edition,Prentice Hall, 2008.
4. M. Tekalp, "Digital Video Processing", 2nd Edition, Prentice Hall, 2015.
5. S. Shridhar, "Digital Image Processing", 2nd Edition, Oxford University Press, 2016.

SP13C DSP Architecture
(Common to Communication Systems)

Instruction Hours/week :(L-T-P-C): 3-1-0-4 **Credits : 4**

Sessional Marks : 40 **Semester-End Examination: 60**

Course Description: This course explains fundamental concepts of Digital Signal Processing and implementation of various applications on Advanced Processor. Helps students to understand architecture of advanced Digital Signal Processor and how to program it for signal processing applications.

Course Objectives:

1. To describe features and architectural improvements of DSP processors.
2. Introduce addressing modes and instruction description of TMS320C6x processors.
3. To demonstrate data representation in DSP Processors and FIR filters.
4. To demonstrate the usefulness of the adaptive filters and learn techniques of code optimization.

Course Outcomes:

1. At the end of this course, students will be able to
2. Identify and formalize architectural level characterization of P-DSP hardware
3. Ability to design, programming (assembly and C), and testing code using Code Composer Studio environment
4. Deployment of DSP hardware for Control, Audio and Video Signal processing applications
5. Understanding of major areas and challenges in DSP based embedded systems.

Syllabus Contents:

Unit 1

Programmable DSP Hardware: Processing Architectures (von Neumann, Harvard), DSP core algorithms (FIR, IIR, Convolution, Correlation, FFT), IEEE standard for Fixed and Floating Point Computations, Special Architectures Modules used in Digital Signal Processors (like MAC unit, Barrel shifters), On-Chip peripherals, DSP benchmarking.

Unit 2

Structural and Architectural Considerations: Parallelism in DSP processing, Texas Instruments, TMS320 Digital Signal Processor Families, Fixed Point TI DSP Processors: TMS320C1X and TMS320C2X Family,TMS320C25 – Internal Architecture, Arithmetic and Logic Unit, Auxiliary Registers,

Addressing Modes (Immediate, Direct and Indirect, Bit-reverse Addressing), Basics of TMS320C54x and C55x Families in respect of Architecture improvements and new applications fields, TMS320C5416 DSP Architecture, Memory Map, Interrupt System, Peripheral Devices, Illustrative Examples for assembly coding.

Unit 3

VLIW Architecture: Current DSP Architectures, GPUs as an alternative to DSP Processors, TMS320C6X Family, Addressing Modes, Replacement of MAC unit by ILP, Detailed study of ISA, Assembly Language Programming, Code Composer Studio, Mixed Cand Assembly Language programming, On-chip peripherals, Simple applications developments as an embedded environment.

Unit 4

Multi-core DSPs: Introduction to Multi-core computing and applicability for DSP hardware, Concept of threads, introduction to P-thread, mutex and similar concepts, heterogeneous and homogenous multi-core systems, Shared Memory parallel programming –OpenMP approach of parallel programming, PRAGMA directives, OpenMP Constructs for work sharing like for loop, sections, TI TMS320C6678 (Eight Core subsystem).

Unit 5

FPGA based DSP Systems: Limitations of P-DSPs, Requirements of Signal processing for Cognitive Radio (SDR), FPGA based signal processing design-case study of a complete design of DSP processor,High Performance Computing using P-DSP: Preliminaries of HPC, MPI, OpenMP, multicore DSP as HPC infrastructure.

References:

1. M. Sasikumar, D. Shikhare, Ravi Prakash, “Introduction to Parallel Processing”, 1st Edition, PHI, 2006.
2. Fayez Gebali, “Algorithms and Parallel Computing”,1st Edition, John Wiley & Sons, 2011
3. Rohit Chandra, Ramesh Menon, Leo Dagum, David Kohr, DrorMaydan, JeffMcDonald,“Parallel Programming in OpenMP”, 1st Edition, Morgan Kaufman,2000.
4. Ann Melnichuk,Long Talk, “Multicore Embedded systems”, 1st Edition, CRC Press,2010.
5. Wayne Wolf, “High Performance Embedded Computing: Architectures, Applications and Methodologies”, 1st Edition, Morgan Kaufman, 2006.
6. E.S.Gopi, “Algorithmic Collections for Digital Signal Processing Applications Using MATLAB”, 1st Edition, Springer Netherlands,2007.

SP14C :Program Elective-I

1. Computer Vision

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination : 60**

Course Description: This course introduces fundamental concepts, theories, and algorithms for pattern recognition and machine learning, which are used in computer vision, speech recognition, data mining, statistics, information retrieval, and bioinformatics. Topics include: Bayesian decision theory, parametric and non-parametric learning, data clustering, component analysis, boosting techniques, support vector machine, and deep learning with neural networks.

Course Objectives:

1. To understand, describe and critique pattern recognition, machine learning and deep learning techniques.
2. To identify and select suitable modeling, learning and prediction techniques to solve a problem.
3. To design and implement a machine learning solution.
4. To appraise ethical and privacy issues of artificial intelligence techniques.

Course Outcomes:

At the end of this course, students will be able to

1. Study the image formation models and feature extraction for computer vision
2. Identify the segmentation and motion detection and estimation techniques
3. Develop small applications and detect the objects in various applications

Syllabus Contents:

Unit 1

Image Formation Models: Monocular imaging system • Orthographic & Perspective Projection • Camera model and Camera calibration • Binocular imaging systems, Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration. Apparel, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration. Apparel, Stereo vision

Unit 2

Feature Extraction

Image representations (continuous and discrete) • Edge detection, Edge

linking, corner detection, texture, binary shape analysis, boundary pattern analysis, circle and ellipse detection, Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.

Unit 3

Shape Representation and Segmentation • Deformable curves and surfaces • Snakes and activecontours • Level set representations • Fourier and wavelet descriptors • Medial representations • Multi-resolution analysis, Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation

Unit 4

Motion Detection and Estimation • Regularization theory • Optical computation • Stereo Vision

Motion estimation, Background Subtraction and Modelling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation • Structure from motion, Motion Tracking in Video

Unit 5

Object recognition • Hough transforms and other simple object recognition methods, Shapecorrespondence and shape matching, Principal component analysis, Shape priors for recognition.

Applications of Computer Vision: Automated Visual Inspection, Inspection of Cereal Grains, Surveillance, In-Vehicle Vision Systems, CBIR, CBVR, Activity Recognition, computational photography, Biometrics, stitching and document processing

References:

1. D. Forsyth and J. Ponce,"Computer Vision - A modern approach", 2nd Edition, Pearson Prentice Hall, 2012
2. Szeliski, Richard, "Computer Vision: Algorithms and Applications", 1st Edition, Springer-Verlag London Limited, 2011.
3. Richard Hartley and Andrew Zisserman, "Multiple View Geometry in Computer Vision", 2nd Edition, Cambridge University Press, 2004.
4. K. Fukunaga,"Introduction to Statistical Pattern Recognition",2ndEdition, Morgan Kaufmann, 1990.
5. Rafael C. Gonzalez and Richard E. Woods," Digital Image Processing", 3rd Edition, Prentice Hall, 2008.
6. B. K. P. Horn, "Robot Vision", 1st Edition, McGraw-Hill, 1986.
7. E. R. Davies"Computer and Machine Vision: Theory, Algorithms, Practicalities", 4th Edition, Elsevier Inc,2012.

SP14C : Program Elective-I

2. Artificial Intelligence

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination : 60**

Course Description: This course introduces fundamental concepts, theories, and algorithms for pattern recognition and machine learning, which are used in computer vision, speech recognition, data mining, statistics, information retrieval, and bioinformatics. Topics include: Bayesian decision theory, parametric and non-parametric learning, data clustering, component analysis, boosting techniques, support vector machine, and deep learning with neural networks.

Course Objectives:

1. To understand, describe and critique pattern recognition, machine learning and deep learning techniques.
2. To identify and select suitable modeling, learning and prediction techniques to solve a problem.
3. To design and implement a machine learning solution.
4. To appraise ethical and privacy issues of artificial intelligence techniques.

Syllabus Contents:

Unit 1

What is AI (Artificial Intelligence)? : The AI Problems, The Underlying Assumption, What are AI Techniques, The Level Of The Model, Criteria For Success, Some General References, One Final WordProblems, State Space Search & Heuristic Search Techniques: Defining The Problems As A State Space Search, Production Systems, Production Characteristics, Production System Characteristics, And Issues In The Design Of Search Programs, Additional Problems. Generate-And-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis.

Unit 2

Knowledge Representation Issues: Representations And Mappings, Approaches To Knowledge
Representation. Using Predicate Logic: Representation Simple Facts In Logic, Representing Instance And Isa Relationships, Computable Functions And Predicates, Resolution. Representing Knowledge Using Rules: Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning.

Unit 3

Symbolic Reasoning Under Uncertainty: Introduction To No monotonic Reasoning, Logics For Non-monotonic Reasoning. Statistical Reasoning: Probability And Bays' Theorem, Certainty.Factors And Rule-Base Systems, Bayesian Networks, Dempster Shafer Theory.

Fuzzy Logic. Weak Slot-and-Filler Structures: Semantic Nets, Frames. Strong Slot-and-Filler

Structures: Conceptual Dependency, Scripts, CYC

Unit 4`

Game Playing: Overview, And Example Domain: Overview, MiniMax, Alpha-Beta Cut-off, Refinements, Iterative deepening, The Blocks World, Components Of A Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems, Other Planning Techniques. Understanding: What is understanding? What makes it hard? As constraint satisfaction

Unit 5

Natural Language Processing: Introduction, Syntactic Processing, Semantic Analysis, Semantic Analysis, Discourse And Pragmatic Processing, Spell Checking Connectionist Models: Introduction: Hopfield Network, Learning In Neural Network, Application of Neural Networks, Recurrent Networks, Distributed Representations, Connectionist AI And Symbolic AI.

References:

1. Elaine Rich and Kevin Knight "Artificial Intelligence", 2nd Edition, Tata Mcgraw-Hill, 2005.
2. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rdEdition, Prentice Hall, 2009.

SP14C : Program Elective-I
3. Wireless Sensor Networks
(Common to Communication Systems)

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination : 60**

Course Description: This course offers an insight into the concepts of mobile and wireless data communication technologies. The objective of this course is to enable the student to understand the emerging technologies of wireless and mobile communications and simulate them.

Course Objectives:

1. To understand the new trends in mobile/wireless communications networks.

2. To understand multiple radio access techniques.
3. To analyze various routing algorithms used in mobile/wireless networks.
4. To identify the issues in transport and application layers.

Course Outcomes:

At the end of this course, students will be able to

1. Design wireless sensor network system for different applications under consideration.
2. Understand the hardware details of different types of sensors and select right type of sensor for various applications.
3. Understand radio standards and communication protocols to be used for wireless sensor network based systems and application.
4. Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms.
5. Handle special issues related to sensors like energy conservation and security challenges.

Syllabus Contents:

Unit 1

Introduction and overview of sensor network architecture and its applications, sensornetwork comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.

Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun

SPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.

Unit 2

Programming tools: C, nesC. Performance comparison of wireless sensor networkssimulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)

Unit 3

Overview of sensor network protocols (details of atleast 2 important protocol per layer):Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy), UWB.

Unit 4

Data dissemination and processing; differences compared with other database managementsystems, data storage; query processing.

Unit 5

Specialized features: Energy preservation and efficiency; security challenges; fault-tolerance, Issues related to Localization, connectivity and

topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network.

References:

1. H. Karl and A. Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, India, 2012.
2. C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, "Wireless Sensor Networks", Springer Verlag, 1st Indian reprint, 2010.
3. F. Zhao and L. Guibas, "Wireless Sensor Networks: An Information Processing Approach", Morgan Kaufmann, 1st Indian reprint, 2013.
4. YingshuLi, MyT. Thai, Weili Wu, "Wireless sensor Network and Applications", Springer series on signals and communication technology, 2008.

SP14C : Program Elective-I

4. Optimization Techniques

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination :60**

Course Description: The students will try to learn the operation research models using optimization techniques based upon the fundamentals of engineering mathematics (minimization and Maximization of objective function). The problem formulation by using linear, dynamic programming, game theory and queuing models.

Course Objectives:

1. Operation research models using optimization techniques based upon the fundamentals of engineering mathematics (minimization and Maximization of objective function).
2. The problem formulation by using linear, dynamic programming, game theory and queuing models.
3. The stochastic models for discrete and continuous variables to control inventory and simulation of manufacturing models for the production decision making.
4. Formulation of mathematical models for quantitative analysis of managerial problems in industry.

Course Outcomes:

At the end of this course, students will be able to

1. Understand importance of optimization
2. Apply basic concepts of mathematics to formulate an optimization problem
3. Analyze and appreciate variety of performance measures for various optimization problems

Syllabus Contents:

Unit 1

Introduction to ClassicalMethods & Linear Programming ProblemsTerminology, Design Variables, Constraints, Objective Function, Problem Formulation. Calculus method, Kuhn Tucker conditions, Method of Multipliers.

Unit 2

Linear Programming Problem,Simplex method, Two-phase method, Big-M method, duality, Integer linear Programming, Dynamic Programming, Sensitivity analysis.

Unit 3

Single Variable Optimization Problems: Optimality Criterion, Bracketing Methods, Region Elimination Methods, Interval Halving Method, Fibonacci Search Method, Golden Section Method. Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method, Cubic search method.

Unit 4

Multi Variable and Constrained Optimization Technique, Optimality criteria, Direct search Method, Simplex search methods, Hooke-Jeeve‘s pattern search method, Powell‘s conjugate direction method,Gradient based method, Cauchy‘s Steepest descent method, Newton‘s method , Conjugate gradient method. Kuhn - Tucker conditions, Penalty Function, Concept of Lagrangian multiplier, Complex search method, Random search method.

Unit 5

Intelligent Optimization Techniques:Introduction to Intelligent Optimization, Soft Computing, Genetic Algorithm: Types of reproduction operators, crossover & mutation, Simulated Annealing Algorithm, Particle Swarm Optimization (PSO) - Graph Grammer Approach - Example Problems

Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

References:

1. S. S. Rao, “Engineering Optimisation: Theory and Practice”, Wiley, 2008.
2. K. Deb, “Optimization for Engineering design algorithms and Examples”, Prentice Hall, 2005.
3. C.J. Ray, “Optimum Design of Mechanical Elements”, Wiley, 2007.
4. R. Saravanan, “Manufacturing Optimization through Intelligent Techniques, Taylor & Francis Publications, 2006.

5. D. E. Goldberg, “Genetic algorithms in Search, Optimization, and Machine learning”,
6. Addison-Wesley Longman Publishing, 1989.

SP15C : Program Elective-II

1. Joint Time Frequency Analysis & Multi Resolution Analysis

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination : 60**

Course Outcomes:

At the end of this course, students will be able to

1. Introduction to Transforms in signal processing
2. To understand Time -Frequency Analysis & Multiresolution
3. Analysis Study of Wavelets and its Applications

Syllabus Contents:

Unit 1

Introduction Review of Fourier Transform, Parseval Theorem and need for joint time-frequency Analysis. Concept of non-stationary signals, Short-time Fourier transforms (STFT), Uncertainty Principle, and Localization/Isolation in time and frequency, Hilbert Spaces, Banach Spaces, and Fundamentals of Hilbert Transform.

Unit 2

Bases for Time-Frequency Analysis: Wavelet Bases and filter Banks, Tilings of Wavelet Packet and Local Cosine Bases, Wavelet Transform, Real Wavelets, Analytic Wavelets, Discrete Wavelets, Instantaneous Frequency, Quadratic time-frequency energy, Wavelet Frames, Dyadic wavelet Transform, Construction of Haar and Roof scaling function using dilation equation and graphical method.

Unit 3

Multiresolution Analysis: Haar Multiresolution Analysis, MRA Axioms, Spanning Linear Subspaces, nested subspaces, Orthogonal Wavelets Bases, Scaling Functions, Conjugate Mirror Filters, Haar 2-band filter Banks, Study of up samplers and down samplers, Conditions for alias cancellation and perfect reconstruction, Discrete wavelet transform and relationship with filter Banks, Frequency analysis of Haar 2-band filter banks, scaling and wavelet dilation equations in time and frequency domains, case study of decomposition and reconstruction of given signal using orthogonal framework of Haar 2band filter bank.

Unit 4

Wavelets: Daubechies Wavelet Bases, Daubechies compactly supported family of wavelets; Daubechies filter coefficient calculations, Case study of Daub-4 filter design, Connection between Haar and Daub-4, Concept of Regularity, Vanishing moments. Other classes of wavelets like Shannon, Meyer, and Battle-Lamarie.

Unit 5

Bi-orthogonal wavelets and Applications: Construction and design. Case studies of biorthogonal 5/3 tap design and its use in JPEG 2000. Wavelet Packet Trees, Time-frequency localization, compactly supported wavelet packets, case study of Walsh wavelet packet bases generated using Haar conjugate mirror filters till depth level 3. Lifting schemes for generating orthogonal bases of second generation wavelets.

JTFA Applications: Riesz Bases, Scalograms, Time-Frequency distributions: fundamental ideas, Applications: Speech,audio, image and video compression; signal denoising, feature extraction, inverse problem.

References:

1. S. Mallat, "A Wavelet Tour of Signal Processing," 2nd Edition, Academic Press, 1999.
2. L. Cohen, “Time-frequency analysis”, 1st Edition, Prentice Hall, 1995.
3. G.Strang and T. Q. Nguyen, “Wavelets and Filter Banks",2nd Edition, Wellesley Cambridge Press, 1998.
4. Daubechies, "Ten Lectures on Wavelets", SIAM, 1992.
5. P. P. Vaidyanathan, "Multirate Systems and Filter Banks", Prentice Hall, 1993.
6. M. Vetterli and J. Kovacevic, "Wavelets and Subband Coding", Prentice Hall, 1995

SP15C : Program Elective-II
2. Voice and Data Networks
(Common to Communication Systems)

Teaching Scheme

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination : 60**

Course Description: This course provides an introduction to voice and data networking technologies, including design and performance issues. And also focus is on layered & cross layer communication along with

Packet and circuit switching communication. Provides Link layer error and flow control mechanisms, also know about queuing models of networks and its applications. Finally have idea about different internet protocols and packet scheduling algorithm.

Course Objectives:

1. Know different design and performance issues of communications networks.
2. Understand the concepts of layered & cross layer communication, along with circuit & packet switching technologies and their deployments in public networks
3. Understand the role of data link layer and various queuing models for communication.
4. Understand the functions of internetworking devices and importance of different internet protocols.

Outcomes:

1. An ability to apply knowledge of networking. network topologies in designing of a network.
2. An ability to model systems using concept of layered/cross layered and TCP/IP architecture.
3. An ability apply the link layer functionalities and queuing models during communication.
4. An ability to use modern engineering techniques for analysis and design of a network with the knowledge of internet concepts and protocols.

Syllabus Contents:

Unit 1

Network Design Issues, Network Performance Issues, Network Terminology, centralized and distributed approaches for networks design, Issues in design of voice and data networks.

Unit 2

Layered and Layer less Communication, Cross layer design of Networks, Voice Networks (wired and wireless) and Switching, Circuit Switching and Packet Switching, Statistical Multiplexing.

Unit 3

Data Networks and their Design, Link layer design- Link adaptation, Link Layer Protocols, Retransmission. Mechanisms (ARQ), Hybrid ARQ (HARQ), Go Back N, Selective Repeat protocols and their analysis.

Unit 4

Queuing Models of Networks , Traffic Models , Little's Theorem, Markov chains, M/M/1 and other Markov systems, Multiple Access Protocols , Aloha System , Carrier Sensing , Examples of Local area networks,

Unit 5

Inter-networking, Bridging, Global Internet, IP protocol and addressing , Sub netting , Classless Inter domain Routing (CIDR) , IP address lookup , Routing in Internet. End to End Protocols, TCP and UDP. Congestion Control, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit/ Fast Recovery,

Congestion avoidance, RED TCP Throughput Analysis, Quality of Service in Packet Networks,Network Calculus, Packet Scheduling Algorithms.

References:

1. D. Bertsekas and R. Gallager, "Data Networks", 2nd Edition, Prentice Hall, 1992.
2. L. Peterson and B. S. Davie, "Computer Networks: A Systems Approach",5th Edition, Morgan Kaufman, 2011.
3. Kumar, D. Manjunath and J. Kuri, "Communication Networking: An analytical approach", 1st Edition, Morgan Kaufman, 2004.
4. Walrand,"Communications Network: A First Course", 2nd Edition, McGraw Hill, 2002.
5. Leonard Kleinrock, "Queueing Systems,Volume I: Theory", 1st Edition, John Wiley and Sons, 1975.
6. Aaron Kershenbaum, "Telecommunication Network Design Algorithms", McGraw Hill, 1993.
7. Vijay Ahuja, "Design and Analysis of Computer Communication Networks", McGrawHill, 1987

SP15C : Program Elective-II

3. Audio Video Coding & Compression

Teaching Scheme

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination : 60**

Course Outcomes:

At the end of this course, students will be able to

1. Familiarity to lossy and lossless compression systems.
2. Study of Video coding techniques and standards.
3. Understand audio coding and multimedia synchronization techniques.

Syllabus Contents:

Unit 1

Introduction to Multimedia Systems and Processing, Lossless Image Compression Systems Image Compression Systems, Huffman Coding, Arithmetic and Lempel-Ziv Coding, Other Coding Techniques

Unit 2

Lossy Image Compression Systems, Theory of Quantization, Delta Modulation and DPCM, Transform Coding & K-L Transforms, Discrete Cosine Transforms, Multi-Resolution Analysis, Theory of Wavelets, Discrete Wavelet Transforms, Still Image Compression Standards: JBIG and JPEG

Unit 3

Video Coding and Motion Estimation: Basic Building Blocks & Temporal Redundancy, Block based motion estimation algorithms, Other fast search motion estimation algorithms

Video Coding Standards MPEG-1 standards, MPEG-2 Standard, MPEG-4 Standard, H.261, H.263 Standards, H.264 standard

Unit 4

Audio Coding, Basic of Audio Coding, Audio Coding, Transform and Filter banks, Polyphase filter implementation, Audio Coding, Format and encoding, Psychoacoustic Models

Unit 5

Multimedia Synchronization, Basic definitions and requirements, References Model and Specification, Time stamping and pack architecture, Packet architectures and audio-video interleaving, Multimedia Synchronization, Playback continuity, Video Indexing And Retrieval: Basics of content based image retrieval, Video Content Representation, Video Sequence Query Processing

References:

1. Iain E.G. Richardson, “H.264 and MPEG-4 Video Compression”, Wiley, 2003.
2. Khalid Sayood, “Introduction to Data Compression”, 4th Edition, Morgan Kaufmann, 2012
3. Mohammed Ghanbari, “Standard Codecs: Image Compression to Advanced Video Coding”, 3rd Edition, The Institution of Engineering and Technology, 2011.
4. Julius O. Smith III, “Spectral Audio Signal Processing”, W3K Publishing, 2011.
5. Nicolas Moreau, “Tools for Signal Compression: Applications to Speech and Audio Coding”, Wiley, 2011.

SP15C : Program Elective-II

4. Modelling and Simulation Techniques

Teaching Scheme

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination :60**

Course Outcomes:

At the end of this course, students will be able to

1. Identify and model discrete systems (deterministic and random)
2. Identify and model discrete signals (deterministic and random)
3. Understand modelling and simulation techniques to characterize systems/processes.

Syllabus Contents:

Unit 1

Introduction Circuitsas dynamicsystems, Transfer functions, poles and zeroes, State space, Deterministic Systems, Difference and Differential Equations, Solution of Linear Difference and Differential Equations, Numerical Simulation Methods for ODEs, System Identification, Stability and Sensitivity Analysis.

Unit 2

Statistical methods, Description of data, Data-fitting methods, Regression analysis, Least Squares Method, Analysis of Variance, Goodness of fit.

Unit 3

Probability and Random Processes, Discrete and Continuous Distribution, Central Limit theorem, Measure of Randomness, MonteCarlo Methods.
Stochastic Processes and Markov Chains, Time Series Models.

Unit 4

Modeling and simulation concepts, Discrete-event simulation, Event scheduling/Time advance algorithms, Verification and validation of simulation models.

Unit 5

Continuous simulation: Modeling with differential equations, Example models, Bond Graph Modeling, Population Dynamics Modeling, System dynamics.

References:

1. 1.R. L. Woods and K. L. Lawrence, "Modeling and Simulation of Dynamic Systems", Prentice-Hall, 1997.
2. 2.Z. Navalih, "VHDL Analysis and Modelling of Digital Systems", McGraw-Hill, 1993.
3. 3.J. Banks, JS. Carson and B. Nelson, "Discrete-Event System Simulation", 2nd Edition, Prentice-Hall of India, 1996.

SP16L: Advanced Digital Signal Processing Lab (Common to Communication Systems)

Instruction Hours/week :3(P) **Credits : 1.5**
Sessional Marks : 40 **Semester-end Examination : 60**

Course Overview: This practical course enables students to apply skills learned in Advanced Digital Signal Processing algorithms and will help to teach implementation of them. MATLAB is used to apply theoretical concepts and to demonstrate signal processing techniques by means of hands-on application examples. Recognize estimation problems and design, implement and analyze algorithms for solving them. Implement signal processing systems with DSP based development platforms.

Pre-requisites: Signals & Systems, Digital Signal Processing, Digital Signal Processing Lab, MATLAB, and Code Composer Studio.

Course Learning Objectives: The student after studying this courseis able to:

1. Understand how to analyze and manipulate digital signals and have the programming knowledge to do so.
2. Understand the trade-offs in the practical design and implement of various structures of FIR and IIR digital filters, for example which can be reduces noise or realizes various applications.
3. Understand theory of prediction and solution of normal equations.
4. Acquaint knowledge of the concepts, algorithms and applications of adaptive signal processing in digital communication systems.
5. Understand the implementation of adaptive filters used in signal processing applications.
6. Understand different methods for estimation of power spectra and its analysis.

Course Outcomes: After completion of this coursethe student is:

1. Able to design, analyze, and implement digital filters using MATLAB.
2. Able to implement various structures of digital filters.

3. Able to implement up-sampling and down-sampling of a given Sequences.
4. Apply the Lattice filter architecture and implement the Wiener filter, Least Squares, LMS and RLS algorithms, and apply to selected applications.
5. Deduce and apply correlation functions and power spectra for various signal classes, in particular for stochastic signals.

Course Contents:

Note: (i) Minimum of 10 Experiments have to be done invariably.
(ii) All Experiments may be Simulated using MATLAB and to be verified theoretically.

List of Experiments:

1. Introduction to DSP with MATLAB Programming Environment and Familiarization to Code Composer Studio.
2. Basic Operations on Signals, Generation of Various Signals and finding its FFT.
3. Simple Digital Filters (LPF, HPF, BPF, BSF and Comb Filters).
4. Realization of Structures (Cascade / Parallel/ Lattice Structure's) of a system transfer function.
5. Implement Program to verify Decimation and Interpolation of a given Sequences.
6. Implement Program to Convert CD data into DVD data (sampling rate converters).
7. Estimation of data series using Nth order Forward Predictor and comparing to the Original Signal.
8. Design of linear prediction coding (LPC) filter using Levinson-Durbin Algorithm.
9. Apply the Lattice filter architecture from the Levinson-Durbin algorithm.
10. Computation of Reflection Coefficients using Schur Algorithm.
11. To implement the Wiener filter, and Least Squares algorithms, and apply to selected applications.
12. To implement the LMS and RLS algorithms, and apply to selected applications.
13. Design and verification of a Matched filter.
14. Adaptive Noise Cancellation / Linear Equalizer.
15. Computing Power Spectrum of a Square Signal and chirp signal.
16. Design and Simulation of Notch Filter to remove 50Hz Hum / any unwanted frequency component of given Signal (Speech / ECG).
17. Plot the Periodogram of a Noisy Signal and estimate PSD using

Periodogram and Modified Periodogram methods.

18. Estimation of Power Spectrum using Bartlett and Welch methods.
19. Parametric methods (Yule-Walker and Burg) of Power Spectrum Estimation.

For Motivated Learners Extra experiments can be done:

Applications: Adaptive filter and experiments on communication such as generation of a N-tuple PN sequence, generation of a white noise sequence using the PN sequence, restoration of a sinusoidal signal embedded in white noise by Wiener Filtering; speech and multi-media applications.

Texts / References:

1. **John G. Proakis** and **Dimitris G. Manolakis,** Digital Signal Processing: Principles, Algorithms and Applications, 5th Edition, **ISBN-13: 9780137348657, Published** by Pearson, 2021.

2. Sanjit Kumar Mitra, Digital Signal Processing: A Computer Based Approach, 4th edition, McGraw Hill Education, 2011.
3. LjiljanaMilić, Multirate Filtering for Digital Signal Processing: MATLAB Applications, Published by Information Science Reference, Hershey PA 17033, New York, ISBN 978-1-60566-178-0 (Hardcover) - ISBN 978-1-60566-179-7 (eBook), 2009.

4. R. Chassaing and D. Reay, Digital Signal Processing and Applications withTMS320C6713 *and* TMS320C6416, Wiley, 2008.

SP17L: Digital Image and Video Processing Lab

Teaching Scheme

Instruction Hours/week :3(P) **Credits : 1.5**
Sessional Marks : 40 **Semester-end Examination : 60**

Course Outcomes:

At the end of this course, students will be able to

1. Perform image and video enhancement.
2. Perform image and video segmentation
3. Detect an object in an image/video

List of Assignments:

1. Perform basic operations on images like addition, subtraction etc.
2. Plot the histogram of an image and perform histogram equalization
3. Implement segmentation algorithms

4. Perform video enhancement
5. Perform video segmentation
6. Perform image compression using lossy technique
7. Perform image compression using lossless technique
8. Perform image restoration
9. Convert a colour model into another
10. Calculate boundary features of an image
11. Calculate regional features of an image
12. Detect an object in an image/video using template matching/Bayes classifier

SP18C: Research Methodology and IPR

Instruction Hours/week : 3L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination : 60**

Description of the Course:
This subjects gives how to proceed systematically for research, present research findings. This course consists of basics of research methods, paper writing , patenting methods and requirements..

Course Educational Objectives (Ceos):

1. To understand the importance of research objectives and procedures.
2. To know the procedures of data collection and report writing of research.
3. To have the knowledge of filing and obtaining a patent on research findings.

UNIT I
Meaning, Objective and Motivation in Research: Types of Research, Research Approaches, Research Process, Validity and Reliability in Research, Research Design: Features of Good Design, Types of Research Design, Basic Principles of Experimental Design

UNIT II
Sampling Design: Steps in Sampling Design, Characteristics of a Good Sample Design, Random Samples and Random Sampling Design Measurement and Scaling Techniques: Errors in Measurement, , Scaling and Scale Construction techniques, Forecasting Techniques, Time Series Analysis, Interpolation and Extrapolation

UNIT III
Methods of Data Collection: Primary Data, Questionnaire and Interviews, Collection of Secondary Data, Cases and Schedules. Professional

Attitude and Goals, Concept of Excellence, Ethics in Science and Engineering, Correlation and Regression Analysis, Method of Least Squares, Regression Vs. Correlation, Correlation Vs. Determination.

UNIT IV

Interpretation of Data and Report Writing, Layout of a Research Paper, Techniques o f Interpretation. Making Scientific Presentation at Conferences and Popular Lectures to Semi Technical Audience, Participating in Pubic Debates on Scientific Issues

UNIT V

Nature of Intellectual property rights, Patents, designs, trademarks and copyrights, History of patenting, process of patenting, patent development, international cooperation on IPR, procedure of granting patent, patent rights, licensing and transferring technology, Geographical Indications ,IPR in biological and systems and software.

Text/Reference Books:

1. Research Methodology: Methods And Techniques - C. R. Kothari,2nd Edition, New Age Intemational Publishers.
2. Statistical Methods - S P. Gupta. S. chand& Sons, New Derhi.
3. Intellectual ProPerty-the law of trademarks, copyrights, Patents, and trade Secrets- Deborah E. Bouchoux, Esq.Georgetown University, Fourth edition

Course Outcomes (COs):

1.Able to know research importance and requirements and procedure

2. Able to apply sampling techniques for analysis and forecasting.

3. Able to use methods for data collection and analyze the data using different mathematical techniques.

4. Able to write report on research done and present the research findings in systematic manner.

5. Able to have the knowledge to file and obtain patent on research finding

Semester - II

SP21C: Pattern Recognition and Machine Learning (Common to Communication Systems)

Instruction Hours/week : (L-T-P-C): 3-1-0-4 **Credits : 4**

Sessional Marks : 40 **Semester-End Examination: 60**

Course Outcomes:

At the end of this course, students will be able to

1. Study the parametric and linear models for classification
2. Design neural network and SVM for classification
3. Develop machine independent and unsupervised learning techniques.

Syllabus Contents:

Unit 1

Introduction to Pattern Recognition: Problems, applications, design cycle, learning andadaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory-Bayes rule, discriminant functions, loss functions and Bayesian error analysis

Unit 2

Linear models: Linear Models for Regression, linear regression, logistic regression LinearModels for Classification

Unit 3

Neural Network: perceptron, multi-layer perceptron, back propagation algorithm, error surfaces,practical techniques for improving back propagation, additional networks and training methods, Adaboost, Deep Learning

Unit 4

Linear discriminant functions - decision surfaces, two-category, multi-category, minimum-squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine

Unit 5

Algorithm independent machine learning – lack of inherent superiority of any classifier, biasand variance, re-sampling for classifier design, combining classifiers

Unsupervised learning and clustering – k-means clustering, fuzzy k-means clustering,hierarchical clustering

References:

1. 1.Richard O. Duda, Peter E. Hart, David G. Stork, “Pattern Classification”, 2nd Edition John Wiley & Sons, 2001.
2. Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, “The Elements of Statistical Learning”, 2nd Edition, Springer, 2009.
3. C. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.

SP22C: Detection and Estimation Theory

Instruction Hours/week : (L-T-P-C): 3-1-0-4 **Credits : 4**

Sessional Marks : 40 **Semester-End Examination: 60**

Course Outcomes:

At the end of this course, students will be able to

1. Understand the mathematical background of signal detection and estimation
2. Use classical and Bayesian approaches to formulate and solve problems for signal detection and parameter estimation from noisy signals.
3. Derive and apply filtering methods for parameter estimation.

Syllabus Contents:

Unit I

Review of Vector Spaces: Vectors and matrices: notation andproperties, orthogonality and linear independence, bases, distance properties, matrix operations, Eigen values and eigenvectors.

Properties of Symmetric Matrices: Diagonalization of symmetric matrices, symmetric positive, definite and semi definite matrices, principal component analysis (PCA), singular value decomposition.

Unit II

Review of Gaussian variables and processes; problem formulation and objective of signal detection and signal parameter estimation in discrete-time domain.

Unit III

Statistical Decision Theory:

Bayesian, minimax, and Neyman-Pearson decision rules, likelihood ratio, receiver operating characteristics, composite hypothesis testing, locally optimum tests, detector comparison techniques, asymptotic relative efficiency.

Unit IV

Detection of Random Signals:

Estimator-correlator, linear model, general Gaussian detection, detection of Gaussian random signal with unknown parameters, weak signal detection.

Unit V

Estimation of Signal Parameters:

Minimum variance unbiased estimation, Fisher information matrix,

Cramer-Rao bound, sufficient statistics, minimum statistics, complete statistics; linear models; best linear unbiased estimation; maximum likelihood estimation, invariance principle; estimation efficiency; Bayesian estimation: philosophy, nuisance parameters, risk functions, minimum mean square error estimation, maximum a posteriori estimation.

References:

1. H. L. Van Trees, "Detection, Estimation and Modulation Theory: Part I, II, and III", John Wiley, NY, 1968.
2. H. V. Poor, "An Introduction to Signal Detection and Estimation", Springer, 2/e,1998.
3. Steven M. Kay, “Fundamentals of Statistical Signal Processing, Volume I: Estimation Theory”, Prentice Hall, 1993
4. Steven M. Kay, “Fundamentals of Statistical Signal Processing, Volume II: Detection Theory”, 1st Edition, Prentice Hall, 1998
5. Thomas Kailath, BabakHassibi, Ali H. Sayed, “Linear Estimation”, Prentice Hall, 2000.
6. H. Vincent Poor, “An Introduction to Signal Detection and Estimation”,2nd Edition, Springer, 1998.

SP23C:Program Elective-III

1. Advanced Computer Architecture

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination : 60**

Course Outcomes:

At the end of this course, students will be able to

1. Understand parallelism and pipelining concepts, the design aspects and challenges.
2. Evaluate the issues in vector and array processors.
3. Study and analyze the high performance scalable multithreaded and multiprocessor systems.

Syllabus Contents:

Unit 1

Parallel Processing and Pipelining Processing- Architectural Classification, Applications ofparallel processing, Instruction level Parallelism and Thread Level Parallelism, Explicitly Parallel Instruction Computing (EPIC) Architecture

Unit 2

Pipeline Architecture-Principles and implementation of Pipelining, Classification of pipeliningprocessors, Design aspect of Arithmetic and

Instruction pipelining, Pipelining hazards and resolving techniques, Data buffering techniques, Advanced pipelining techniques, Software pipelining, VLIW (Very Long Instruction Word) processor.

Unit 3

Vector and Array Processor- Issues in Vector Processing, Vector performance modeling, SIMD Computer Organization, Static Vs Dynamic network, Parallel Algorithms for Array Processors: Matrix Multiplication.

Unit 4

Multiprocessor Architecture - Loosely and Tightly coupled multiprocessors, Inter Processorcommunication network, Time shared bus, Multiport Memory Model, Memory contention and arbitration techniques, Cache coherency and bus snooping, Massively Parallel Processors (MPP).

Unit 5

Multithreaded Architecture- Multithreaded processors, Latency hiding techniques, Principles ofmultithreading, Issues and solutions, Parallel Programming Techniques: Message passing program development.

Parallel algorithms for multiprocessors- Classification and performance of parallel algorithms,operating systems for multiprocessors systems, Message passing libraries for parallel programming interface, PVM (in distributed memory system), Message Passing Interfaces (MPI).

References:

1. Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing" McGraw Hill Education, 2012.
2. Kai Hwang, "Advanced Computer Architecture", McGraw Hill Education, 1993.
3. William Stallings, "Computer Organization and Architecture, Designing for Performance" Prentice Hall, 6th edition, 2006.
4. Kai Hwang, "ScalableParallelComputing", McGraw Hill Education, 1998.
5. Harold S. Stone "High-Performance Computer Architecture", Addison-Wesley, 1993.

SP23C:Program Elective-III

2. IOT and Applications

(Common to Communication Systems)

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination : 60**

Course Objectives:

1. To apprise students with basic knowledge of IoT that paves a platform to understand physical and logical design of IOT
2. To teach a student how to analyse requirements of various communication models and protocols for cost-effective design of IoT

applications on different IoT platforms.
3. To introduce the technologies behind Internet of Things (IoT).
4. To explain the students how to code for an IoT application using Arduino/Raspberry Pi open platform.

Syllabus Contents:

UNIT I
THE INTERNET OF THINGS TODAY, TIME FOR CONVERGENCE
M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structurefor IoT, The international driven global valuechain and global information monopolies. M2M to IoT-An Architectural Overview– Building anarchitecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

UNIT II
COMPONENTS IN INTERNET OF THINGS
Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee,Wi-Fi, GPS, GSM Modules)

UNIT III
PROTOCOLS AND TECHNOLOGIES BEHIND IOT
IOT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, BigData Analytics, Cloud Computing, Embedded Systems.

UNIT IV
OPEN PLATFORMS AND PROGRAMMING
IOT deployment for Raspberry Pi /Arduino platform-Architecture – Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.

UNIT V
IOT APPLICATIONS
Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture

COURSE OUTCOMES:
Upon completion of the course, students will be able to
1. Explain the concept of IoT.
2. Understand the communication models and various protocols for IoT.
3. Design portable IoT using Arduino/Raspberry Pi/open platform.

4. Apply data analytics and use cloud offerings related to IoT.
5. Analyze applications of IoT in real time scenario.

TEXT BOOKS:

1. Dr. Ovidiu Vermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers, Aalborg, 2013
2. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, CISCO Press, 2017
3. Samuel Greengard, The Internet of Things, The MIT Press, 2015

REFERENCES:

1. Perry Lea, “Internet of things for architects”, Packt, 2018
2. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things – Key applications and Protocols”, Wiley, 2012
3. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.
5. ArshdeepBahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015.
6. https://www.arduino.cc/https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet.

SP23C:Program Elective-III
3. Digital Design and Verification

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination : 60**

Course Outcomes:

At the end of this course, students will be able to

1. Familiarity of Front end design and verification techniques and create reusable test environments.
2. Verify increasingly complex designs more efficiently and effectively.
3. Use EDA tools like Cadence, Mentor Graphics.

Syllabus Contents:

Unit 1

Revision of basic Digital systems: Combinational Circuits, Sequential Circuits, Logic families, Synchronous FSM and asynchronous design,

Metastability, Clock distribution and issues, basic building blocks like PWM module, pre-fetch unit, programmable counter, FIFO, Booth's multiplier, ALU, Barrel shifter etc.

Unit 2

Verilog/VHDL Comparisons and Guidelines, Verilog: HDL fundamentals, simulation, and test-bench design, Examples of Verilog codes for combinational and sequential logic, Verilog AMS

Unit 3

System Verilog and Verification: Verification guidelines, Data types, procedural statements and routines, connecting the test bench and design, Assertions, Basic OOP concepts, Randomization, Introduction to basic scripting language: Perl, Tcl/Tk

Unit 4

Current challenges in physical design: Roots of challenges, Delays: Wire load models Generic PD flow, Challenges in PD flow at different steps, SI Challenge - Noise & Crosstalk, IR Drop, Process effects: Process Antenna Effect &Electromigration

Unit 5

Programmable Logic Devices: Introduction, Evolution: PROM, PLA, PAL, Architecture of PAL's,

Applications, Programming PLD's, FPGA with technology: Antifuse, SRAM, EPROM, MUX, FPGA structures, and ASIC Design Flows, Programmable Interconnections, Coarse grained reconfigurable devices

IP and Prototyping: IP in various forms: RTL Source code, Encrypted Source code, Soft IP, Netlist, Physical IP, and Use of external hard IP during prototyping, Case studies, and Speed issues. Testing of logic circuits: Fault models, BIST, JTAG interface

References:

1. Douglas Smith, “HDL Chip Design: A Practical Guide for Designing, Synthesizing & Simulating ASICs & FPGAs Using VHDL or Verilog”, Doone publications, 1998.
2. Samir Palnitkar, “Verilog HDL: A guide to Digital Design and Synthesis”, Prentice Hall, 2nd Edition, 2003.
3. Doug Amos, Austin Lesea, Rene Richter, “FPGA based Prototyping Methodology Manual”, Synopsys Press, 2011.
4. Christophe Bobda, “Introduction to Reconfigurable Computing, Architectures, Algorithms and Applications”, Springer, 2007.
5. Janick Bergeron, “Writing Testbenches: Functional Verification of HDL Models”, Second Edition, Springer, 2003.

SP23C:Program Elective-III
4. Audio Processing

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination : 60**

Course Outcomes:
At the end of this course, students will be able to
1. Understand different characteristics of Speech.
2. Identify and analyze different speech analysis system.
3. Write algorithms for Recognition of speech.

Syllabus Contents:

Unit 1
Principle Characteristics of Speech: Linguistic information, Speech and Hearing, Speech production mechanism, Acoustic characteristic of speech Statistical Characteristics of speech. Speech production models, Linear Separable equivalent circuit model, Vocal Tract and Vocal Cord Model.

Unit 2
Speech Analysis and Synthesis Systems: Digitization, Sampling, Quantization and coding, Spectral Analysis, Spectral structure of speech, Autocorrelation and Short Time Fourier transform, Window function, Sound Spectrogram, Mel frequency Cepstral Coefficients, Filter bank and Zero Crossing Analysis, Analysis –by-Synthesis, Pitch Extraction.

Unit 3
Linear Predictive Coding Analysis: Principle of LPC analysis, Maximum likelihood spectral estimation, Source parameter estimation from residual signals, LPC Encoder and Decoder, PARCOR analysis and Synthesis, Line Spectral Pairs, LSP analysis and Synthesis.

Unit 4
Speech Coding: Reversible coding, Irreversible coding and Information rate distortion theory,
coding in time domain: PCM, ADPCM, Adaptive Predictive coding, coding in Frequency domain: Sub band coding, Adaptive transform coding, Vector Quantization, Code Excited Linear Predictive Coding (CELP).

Unit 5
Speech Recognition: Principles of speech recognition, Speech period detection, Spectral distance measure, Structure of word recognition system, Dynamic Time Warping (DTW), Theory and implementation of Hidden

Markov Model (HMM).
Speaker recognition: Human and Computer speaker recognition Principles Text dependent and Text Independent speaker recognition systems. Applications of speech Processing.

References:

1. SadaokiFurui, "Digital Speech Processing, Synthesis and Recognition" 2nd Edition, Taylor & Francis, 2000.
2. Rabiner and Schafer, "Digital Processing of Speech Signals", Pearson Education, 1979.

SP24C:Program Elective-IV
1. Random Processes and Queuing Models
(Common to Communication Systems)

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination : 60**

Prerequisites: Probability Theory and Stochastic Processes

Preamble: This course is designed to provide necessary basic concepts in random processes which are widely applied in random signals, linear systems in communication engineering and IT fields. The objective of this course is to familiarize the understanding of stochastic processes and queuing models. The syllabus also covers the concepts of Markovian and advanced queueing models which are essential to design and analyze communication networks.

Course Learning Objectives: The objectives of this course is to enable the student to

1. Characterize stochastic processes with an emphasis on stationary random processes.
2. Use the properties of random processes with LTI systems in real world situations.
3. Understand Markov chains and their transient behavior.
4. Differentiate between different models of queuing theory and their performance measures.
5. Understand network of queues with Poisson external arrivals, exponential service requirements and independent routing.

Course Outcomes: At the end of the course, the students will be able to

1. Analyze the various classifications of Random Processes and characterize. phenomena which evolve with respect to time in a probabilistic manner.
2. Apply the ideas of Random Processes to the LTI Systems for Spectral analysis.
3. Understand Markov Chains and regenerative processes used in modeling a

wide variety of systems.
4. Understand the basic characteristic features of a queuing system and acquire skills in analyzing queuing models.
5. Analyze the performance of the queuing networks.

UNIT I

REVIEW OF RANDOM PROCESSES: Classification of General Random Processes, Binomial Processes, Poisson Processes, Ergodic Process, Gaussian Random Processes, Stationary and Wide Sense Stationary Random Processes, Random walks and gambler's ruin, Processes with independent increments and martingales, Brownian motion, Counting processes and the Poisson process, Stationarity, Joint properties of random processes.

UNIT II

RANDOM PROCESSES IN LINEAR SYSTEMS AND SPECTRAL ANALYSIS: Basic definitions, Spectral Density Function, transfer functions and power spectral densities, Discrete-time processes in linear systems, Low Pass and Band Pass Processes, Baseband random processes, Narrowband random processes.

UNIT III

MARKOV PROCESSES: Markov Chains, Probability Distribution of a Markov Chain, Transition Probability Matrices of a Markov Chain, Classification of States and Chains, Chapman-Kolmogorov Theorem, Stationary Distribution for a Markov Chains, Classification of States of a Markov Chain, Birth and Death Processes, Renewal Process, The Transition Probability Function, Limiting Probabilities, Exponential Distribution & Poison Process.

UNIT IV

QUEUING THEORY: Basic Characteristics of Queueing Models, Introduction to Markovian queueing models, Steady state distribution, Little's Theorem, Cost equations, steady state probabilities, Queuing Models: **(M/M/1) : (∞/FIFO)** Single server with infinite system capacity, **(M/M/1) : (k/FIFO)** Single Server with Finite Capacity, **(M/M/s) : (∞/FIFO)** Multiple Server with Infinite Capacity, **(M/M/s) : (k/FIFO)** Multiple Server with Finite Capacity, models balance equations, Erlang's B and C formulae, M/G/1 Queuing system characteristics, Queues with finite waiting rooms – Queues with impatient customers: Balking and reneging.

Unit V

QUEUEING NETWORKS: Network of queues basic concepts, Tandem Queues, Channels in Series or Jackson Networks, Queues in series with multiple channels at each phase, Closed Jackson Networks, Approximating

Closed Networks, Open Networks with General Customer Routes, Symmetric Queues.

Text Books:

1. Sheldon M. Ross, Introduction to Probability Models, 10th Edition, Elsevier, 2010.
2. T Veera Rajan , Probability, Statistics and Random Process, 3rd Edition, Tata Mc Graw Hill, 2008.
3. R. D. Yates and D. J. Goodman, "Probability and Stochastic Processes: A Friendly Introduction for Electrical and Computer Engineers", 3rd Edition International Student Version, Wiley, 2014.

Reference Books:

1. J.F. Shortle, J.M. Thompson, D. Gross and C.M. Harris, Fundamentals of Queueing Theory, 5th Edition, Wiley, 2018.
2. J. Medhi, Stochastic Models in Queueing Theory, 2nd Edition, Academic Press, 2003.
3. U.N. Bhat, An Introduction to Queueing Theory, Springer, 2015.

SP24C:Program Elective-IV
2. Multispectral Signal Analysis

Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination : 60**

Course Outcomes:

At the end of this course, students will be able to

1. Select appropriate hyperspectral data for a particular application.
2. Understand basic concepts of data acquisition and image processing tasks required for multi and hyperspectral data analysis
3. Learn techniques for classification and analysis of multi and hyperspectral data.

Syllabus Contents:

Unit 1

Hyperspectral Sensors and Applications: Introduction, Multi-spectral Scanning Systems (MSS), Hyperspectral Systems, Airborne sensors, Spaceborne sensors, Ground Spectroscopy, Software for Hyperspectral Processing, Applications, Atmosphere and Hydrosphere, Vegetation, Soils and Geology, Environmental Hazards and Anthropogenic Activity

Unit 2

Overview of Image Processing: Introduction, Image File Formats, Image Distortion and Rectification, Radiometric Distortion, Geometric Distortion

and Rectification, Image Registration, Image Enhancement, Point Operations, Geometric Operation, Image Classification, Supervised Classification, Unsupervised Classification, Crisp Classification Algorithms, Fuzzy Classification Algorithms, Classification Accuracy Assessment, Image Change Detection, Image Fusion, Automatic Target Recognition

Unit 3

Mutual Information: A Similarity Measure for Intensity Based Image Registration: Introduction, Mutual Information Similarity Measure, Joint Histogram Estimation Methods, Two-Step Joint Histogram Estimation, One-Step Joint Histogram Estimation, Interpolation Induced Artifacts, Generalized Partial Volume Estimation of Joint Histograms, Optimization Issues in the Maximization of MI

Unit 4

Independent Component Analysis: Introduction, Concept of ICA, ICA Algorithms, Preprocessing using PCA, Information Minimization Solution for ICA, ICA Solution through Non-Gaussianity Maximization, Application of ICA to Hyperspectral Imagery, Feature Extraction Based Model, Linear Mixture Model Based Model, An ICA algorithm for Hyperspectral Image Processing, Applications using ICA.

Unit 5

Support Vector Machines : Introduction, Statistical Learning Theory, Empirical Risk Minimization, Structural Risk Minimization, Design of Support Vector Machines, Linearly Separable Case, Linearly Non-Separable Case, Non-Linear Support Vector Machines, SVMs for Multiclass Classification, One Against the Rest Classification, Pair wise Classification, Classification based on Decision Directed Acyclic Graph and Decision Tree Structure, Multiclass Objective Function, optimization Methods , Applications using SVM.

Markov Random Field Models: Introduction, MRF and Gibbs Distribution, Random Field and Neighborhood ,Cliques, Potential and Gibbs Distributions, MRF Modeling in Remote Sensing Applications, Optimization Algorithms, Simulated Annealing, Metropolis Algorithm, Iterated Conditional Modes Algorithm

References:

1. 1.Pramod K. Varshney, Manoj K. Arora, “Advanced Image Processing Techniques for Remotely Sensed Hyperspectral Data”, Springer, 2013.
2. 2.S. Svanberg, “Multi-spectral Imaging– from Astronomy to Microscopy– from Radio waves to Gamma rays”, Springer Verlag, 2009

SP24C:Program Elective-IV
3. Biomedical Signal Processing

Teaching Scheme
Instruction Hours/week : 3(L) **Credits : 3**
Sessional Marks : 40 **Semester-end Examination : 60**

Course Outcomes:

At the end of this course, students will be able to

1. Understand different types of biomedical signal.
2. Identify and analyze different biomedical signals
3. Find applications related to biomedical signal processing

Syllabus Contents:

Unit 1

Acquisition, Generation of Bio-signals,Origin of bio-signals, Types of bio-signals,Study of diagnostically significant bio-signal parameters

Unit 2

Electrodes for bio-physiological sensing and conditioning, Electrode-electrolyte interface, polarization, electrode skin interface and motion artefact, biomaterial used for electrode, Types of electrodes (body surface, internal, array of electrodes,microelectrodes), Practical aspects of using electrodes, Acquisition of bio-signals (signal conditioning) and Signal conversion (ADC's DAC's) Processing, Digital filtering

Unit 3

Biomedical signal processing by Fourier analysis, Biomedical signal processing by wavelet (time-frequency) analysis, Analysis (Computation of signal parameters that are diagnostically significant),Classification of signals and noise, Spectral analysis of deterministic, stationary random signals and non-stationary signals.

Unit 4

Coherent treatment of various biomedical signal processing methods and applications.

Principal component analysis, Correlation and regression, Analysis of chaotic signals Application areas of Bio–Signals analysis Multiresolution analysis(MRA) and wavelets, Principal component analysis(PCA), Independent component analysis(ICA)

Unit 5

Pattern classification–supervised and unsupervised classification, Neural networks, Support vector Machines, Hidden Markov models. Examples of

biomedical signal classification examples.

References:

1. W. J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall, 1993.
2. Eugene N Bruce, "Biomedical Signal Processing and Signal Modeling", John Wiley & Son's publication, 2001.
3. Myer Kutz, "Biomedical Engineering and Design Handbook, Volume I", McGraw Hill, 2009.
4. D C Reddy, "Biomedical Signal Processing", McGraw Hill, 2005.
5. Katarzyn J. Blinowska, JaroslawZygierewicz, "Practical Biomedical Signal Analysis Using MATLAB", 1st Edition, CRC Press, 2011.

SP24C:Program Elective-IV

4. Remote Sensing

(Common to Communication Systems)

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination :60**

Course Outcomes:

At the end of this course, students shall be able to

1. Understand basic concepts, principles and applications of remote sensing, particularly the geometric and radiometric principles
2. Provide examples of applications of principles to a variety of topics in remote sensing, particularly related to data collection, radiation, resolution, and sampling.

Syllabus Contents:

Unit 1

Physics Of Remote Sensing: Electro Magnetic Spectrum, Physics of Remote Sensing-Effects of Atmosphere-Scattering–Different types–Absorption-Atmospheric window-Energy interaction with surface features –Spectral reflectance of vegetation, soil and water atmospheric influence on spectral response patterns-multi concept in Remote sensing.

Data Acquisition: Types of Platforms–different types of aircrafts-Manned and Unmanned space crafts–sun synchronous and geo synchronous satellites –Types and characteristics of different platforms –LANDSAT, SPOT, IRS, INSAT, IKONOS, QUICKBIRDetc.

Unit 2

Photographic products, B/W,color, color IR film and their characteristics – resolving power of lens and film - Optomechanical electro optical sensors – across track and along track scanners-multispectral scanners and thermal scanners–geometric characteristics of scanner imagery - calibration of

thermal scanners.

Unit 3

Scattering System: Microwave scatterometry, types of RADAR –SLAR – resolution –range and azimuth –real aperture and synthetic aperture RADAR. Characteristics of Microwave images topographic effect-different types of Remote Sensing platforms –airborne and space borne sensors - ERS, JERS, RADARSAT, RISAT -Scatterometer, Altimeter-LiDAR remote sensing, principles, applications.

Unit 4

Thermal And Hyper Spectral Remote Sensing: Sensors characteristics-principle of spectroscopy-imaging spectroscopy–field conditions, compound spectral curve, Spectral library, radiative models, processing procedures, derivative spectrometry, thermal remote sensing –thermal sensors, principles, thermal data processing, applications.

Unit 5

Data Analysis: Resolution–Spatial, Spectral, Radiometric and temporal resolution-signal to noise ratio-data products and their characteristics-visual and digital interpretation–Basic principles of data processing – Radiometric correction–Image enhancement–Image classification–Principles of LiDAR, Aerial Laser Terrain Mapping.

References:

1. Lillesand.T.M. and Kiefer.R.W,"Remote Sensing and Image interpretation", 6thEdition, John Wiley & Sons, 2000.
2. John R. Jensen, "Introductory Digital Image Processing: A Remote Sensing Perspective", 2nd Edition, Prentice Hall,1995.
3. Richards, John A., Jia, Xiuping, "Remote Sensing Digital Image Analysis", 5th Edition, Springer-Verlag Berlin Heidelberg, 2013.
4. Paul Curran P.J. Principles of Remote Sensing, 1st Edition, Longman Publishing Group, 1984.
5. Charles Elachi, Jakob J. van Zyl, "Introduction to The Physicsand Techniques of Remote Sensing", 2nd Edition, Wiley Serie, 2006.
6. Sabins, F.F.Jr, "Remote Sensing Principles and Image Interpretation", 3rd Edition,W.H.Freeman& Co, 1978

SP25C: Pattern Recognition & Machine Learning Lab

Teaching Scheme

Instruction Hours/week :3(P) **Credits : 1.5**

Sessional Marks : 40 **Semester-end Examination : 60**

Course Outcomes:

At the end of this course, students will be able to

1. Perform image and video enhancement
2. Perform image and video segmentation
3. Detect an object in an image/video

List of Assignments:

1. Implement maximum likelihood algorithm
2. Implement Bayes classifier
3. Implement linear regression
4. Design a classifier using perceptron rule
5. Design a classifier using feedforward back-propagation and delta rule algorithms
6. Implement deep learning algorithm
7. Implement linear discriminant algorithm
8. Design a two class classifier using SVM
9. Design a multiclass classifier using SVM
10. Perform unsupervised learning

SP26C: Detection and Estimation Theory Lab

Teaching Scheme

Instruction Hours/week :3(L) **Credits : 1.5**

Sessional Marks : 40 **Semester-end Examination : 60**

Course Outcomes:

Syllabus Contents:

At the end of this course, students will be able to

1. Simulate signals and noise
2. Detect signals in the presence of noise
3. Compare various estimation techniques

List of Assignments:

1. Simulate signal and noise models models.
2. Simulate spatially separated target Signal in the presence of Additive Correlated White Noise
3. Simulate spatially separated target Signal in the presence of Additive Uncorrelated White Noise
4. Simulate spatially separated target Signal in the presence of Additive Correlated Colored Noise
5. Detect Constant amplitude Signal in AWGN

6. Detect Time varying Known Signals in AWGN
7. Detect Unknown Signals in AWGN
8. Compare performance comparison of the Estimation techniques - MLE, MMSE, Bayes Estimator, MAP Estimator, Expectation Maximization (EM) algorithm
9. Performance comparison of conventional Energy Detectors and Coherent Matched Filter Techniques

CM27C:Cyber Security

Course Type:	**Value Added**	**Semester:**	**II Sem**	**Credits :**	**3**
Course Code:	**CM27C**	**Theory :**	**2 Hrs/Week**	**Practical :**	**2Hrs/ Week**
		Assessment:	**Lab reports and written exams**	**Internal Continuous Assessment:**	**100 M**

Course Overview / Description: Cyber security is perhaps the most important topic in today environment. Demand for cyber security professionals has exploded, in the private and public sectors alike. Student can learn how to defend information systems from cyber attacks, how to recover compromised systems, how to architect secure systems and so much more. This course is focuses on the models, tools, and techniques for enforcement of security with some emphasis on the use of cryptography. Students will learn security from multiple perspectives.

Course Learning Objectives:

1. To prepare students with the technical knowledge and skills needed to protect and defend computer systems and networks from cyber security attacks.
2. To develop graduates that can plan, implement, and monitor cyber security mechanisms to help ensure the protection of information technology assets.
3. To develop graduates that can identify, analyze, and remediate computer security breaches.

Course Outcomes: After completing this course student will be:

1. Be able to understand the basic terminologies related to cyber security and current cyber security threat landscape. They will also develop understanding about the Cyber warfare and necessity to strengthen the cyber security of end user machine, critical IT and national critical infrastructure.
2. Have complete understanding of the cyber attacks that target computers, mobiles and persons. They will also develop understanding about the type and nature of cyber crimes and as to how report these crimes through the prescribed legal and Government channels.

3. Be able to understand the legal framework that exist in India for cyber crimes and penalties and punishments for such crimes, It will also expose students to limitations of existing IT Act, 2000 legal framework that is followed in other countries and legal and ethical aspects related to new technologies.
4. Understand the aspects related to personal data privacy and security. They will also get insight into the Data Protection Bill, 2019 and data privacy and security issues related to Social media platforms.
5. Understand the main components of cyber security plan. They will also get insights into risk-based assessment, requirement of security controls and need for cyber security audit and compliance.

Unit- I Overview of Cyber security

Cyber security increasing threat landscape, Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker., Non-state actors, Cyber terrorism, Protection of end user machine, Critical IT and National Critical Infrastructure, Cyber warfare, Case Studies.

Unit-II Cyber Crimes

Cyber crimes targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach., Online scams and frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Online sextortion, Debit/ credit card fraud, Online payment fraud, Cyber bullying, website defacement, Cyber squatting, Pharming, Cyber espionage, Cryptojacking, Darknet- illegal trades, drug trafficking, human trafficking., Social Media Scams & Frauds- impersonation, identity theft, job scams, misinformation, fake news cyber crime against persons - cyber grooming, child pornography, cyber stalking., Social Engineering attacks, Cyber Police stations, Crime reporting procedure, Case studies.

Unit-III Cyber Law

Cyber crime and legal landscape around the world, IT Act, 2000 and its amendments, Limitations of IT Act, 2000,Cyber crime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies- AI/ML, IoT, Blockchain, Darknet and Social media, Cyber Laws of other countries, Case Studies.

Unit-IV Data Privacy and Data Security

Defining data, meta-data, big data, non-personal data. Data protection, Data privacy and data security, Personal Data Protection Bill and its compliance, Data protection principles, Big data security issues and challenges, Data protection regulations of other countries- General Data Protection Regulations(GDPR), 2016 Personal Information Protection and Electronic Documents Act (PIPEDA), Social media- data privacy and security issues.

Unit-V Cyber security Management, Compliance and Governance:

Cyber security Plan- cyber security policy, cyber crises management plan, Business continuity, Risk assessment, Types of security controls and their goals, Cyber security audit and compliance, National cyber security policy and strategy.

Practical Work

The practical list has been suggested for the applicable modules; however, the faculty may expand the list as per the syllabus content duly taking into consideration the emerging nature

of cyber threats and incumbent protective measures to guard against such threats.

Practical list of Experiments:

1. Platforms for reporting cyber crimes.
2. Checklist for reporting cyber crimes online.
3. Setting privacy settings on social media platforms.
4. Do's and Don'ts for posting content on Social media platforms.
5. Registering complaints on a Social media platform.
6. Prepare password policy for computer and mobile device.
7. List out security controls for computer and implement technical security controls in the personal computer.
8. List out security controls for mobile phone and implement technical security controls in the personal mobile phone.
9. Log into computer system as an administrator and check the security policies in the system.

Text Books/ References:

1. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.
2. Information Warfare and Security by Dorothy F. Denning, Addison Wesley.
3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform.
4. Data Privacy Principles and Practice by Natraj Venkataramanan and Ashwin Shriram, CRC Press.
5. Information Security Governance, Guidance for Information Security Managers by W. KragBrothy, 1st Edition, Wiley Publication.
6. Auditing IT Infrastructures for Compliance By Martin Weiss, Michael G. Solomon, 2nd Edition, Jones Bartlett Learning.

SP28M: Mini Project with Seminar

Instruction Hours/week : 4(P) **Credits : 2**
Sessional Marks :100 **Semester-end Examination :-**

Course Outcomes:

At the end of this course, students will be able to

1. Understand of contemporary / emerging technology for various processes and systems.
2. Share knowledge effectively in oral and written form and formulate documents.

Syllabus Contents:

The students are required to search / gather the material / information on a specific a topic comprehend it and present / discuss in the class.

Semester III & IV
SP33D& SP41D (Dissertation) Dissertation Work Phase – I, Phase – II and Viva-Voce

Instruction Hours/week : 24+20(P) **Credits : 12+16**
Sessional Marks : 40+40 **Semester-end Examination :60+60**

Course Outcomes:

At the end of this course, students will be able to

1. Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
2. Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
3. Ability to present the findings of their technical solution in a written report.
4. Presenting the work in International/ National conference or reputed journals.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

- Relevance to social needs of society
- Relevance to value addition to existing facilities in the institute
- Relevance to industry need
- Problems of national importance
- Research and development in various domain

The student should complete the following:

- Literature survey Problem Definition
- Motivation for study and Objectives
- Preliminary design / feasibility / modular approaches
- Implementation and Verification
- Report and presentation

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

- Experimental verification / Proof of concept.
- Design, fabrication, testing of Communication System.
- The viva-voce examination will be based on the above report and

work.

Guidelines for Dissertation Phase – I and II at M. Tech. (Electronics):

- As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.
- The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.
- After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.
- Student is expected to detail out specifications, methodology, resources required, critical issues involve*d in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.
- Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.
- Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.
- During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.
- Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, a record of continuous progress.
- Phase – II evaluation: Guide along with appointed external examiner shall assess the
- progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may

recommend for extension or repeating the work.

******

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI
DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

Dr. Ch Chengaiah Ph.: 0877-2249900
Professor & Chairman, BoS (PG).

05-06-2023,
Tirupati.

To
The Registrar.
S.V. University,
Tirupati.

"Through the Dean Faculty of Engineering"

Sir,

Sub: SVUCE- Dept. of EEE - Submission of Scheme of instructions and Syllabus - M.Tech (Power Systems) - R23 Regulation – W.e.f. ACY 2023-24 - Reg.

Ref: 1. SVUCE/ Dean/ JBOS M.Tech/ (PG)/2023.Dated.11/04/2023
2. CII (B)/Joint BoS (PG) Meeting/Engg/2022 Dated.18.05.2023.

*****

With reference to the subject cited, the Joint Board of Studies meeting was held on 02/06/2023 and as per the Dean Faculty of Engineering instructions individual Board of Studies meeting was held in the Department of Electrical and Electronics Engineering on the same day.

However, based on Internal and External members discussions and suggestions the scheme of instructions and syllabus are prepared and approved the same for M.Tech (Power Systems) Program with effect from the Academic Year 2023-24 onwards.

In this connection, herewith I am submitting the Scheme of Instructions and Syllabus of the M.Tech (Power System) program. This is for your kind information.

Thanking You, Sir

Yours faithfully,

Professor & Head of the Department of
Electricals and Electronics Engg.,
S.V.U. COLLEGE OF ENGINEERING
TIRUPATI - 517 502

Dr. Ch Chengaiah
Professor & Chairman, BoS (PG).
Electrical & Electronics Engineering

CHAIRMAN
B.O.S. (P.G.)
Dept. of E.E.E.

Encl: 1. Resolution of M.Tech BoS(PG) meeting
2. Scheme of Instructions of the M.Tech (Power System) program } → in Book form
3. Syllabus of the M.Tech (Power System) program

Copy to The Dean, Faculty of Engineering for information.
Copy to file.

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING::TIRUPATI
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Date: 02.06.2023

RESOLUTION

1. It is resolved to approve the Scheme of instructions and Syllabus for M.Tech (Power Systems) Curriculum to be implemented for the Academic year 2023-24, as per NEP / AICTE / UGC Guidelines.

2. It is resolved to authorize BOS Chairman to carryout minor modifications for the Scheme of instructions and Syllabus if necessary.

S.No	NAME OF THE MEMBER	SIGNATURE
1.	**Prof. Ch. Chengaiah** Chairman, BOS	
2.	**The Head,** Dept. of EEE Ex-Officio Member	
3.	**Prof. M. Damodar Reddy** Member, BOS	
4.	**Prof. A. Lakshmi Devi** Member, BOS	
5.	**Dr. V. Usha Reddy** Member, BOS	
6.	**Dr. Siva Nagaraju Sirigiri** External Member, JNTUK - Kakinada	Attended online
7.	**Dr. K. Srinivas** External Member, SE – AP TRANSCO, Nellore.	Attended online

BOS (PG), CHAIRMAN
CHAIRMAN
B.O.S. (P.G.)
Dept. of E.E.E.

HEAD, DEPT. OF EEE
Professor & Head of the Department of
Electricals and Electronics Engg.,
S.V.U. COLLEGE OF ENGINEERING
TIRUPATI - 517 502

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING::TIRUPATI

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

M.TECH WITH SPECIALIZATION – POWER SYSTEMS



SCHEME OF INSTRUCTIONS AND SYLLABUS

R23 – REGULATIONS

(w.e.f. ACY 2023-24)

DEPARTMENT OF

ELECTRICAL AND ELECTRONICS ENGINEERING

SCHEME OF INSTRUCTIONS

(R23 REGULATIONS)



SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Scheme of Instruction- (CBCS) Effective from the Academic Year 2023-24

Specialization: M. Tech (Power Systems)

M.Tech (Power Systems) - I Semester

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	PSPC 01	Computer Methods in Power Systems.	4	0	0	4	4	40	60	100
PCC	PSPC 02	Interconnected Power System Operation and Control.	4	0	0	4	4	40	60	100
PCC	PSPC03	AI Applications to Power Systems.	4	0	0	4	4	40	60	100
PEC	PSPE 01	Program Elective I.	3	1	0	4	3	40	60	100
PEC	PSPE 02	Program Elective II.	3	1	0	4	3	40	60	100
PCL	PSCP 01	Computer Methods in Power Systems Lab.	0	0	3	3	1.5	40	60	100
PCL	PSCP 02	AI Applications to Power Systems Lab.	0	0	3	3	1.5	40	60	100
MC	PGMC01	Research Methodology and IPR.	3	0	0	3	3	40	60	100
Total			**18**	**03**	**06**	**27**	**24**	**320**	**480**	**800**

Course Code	List of Program Elective Course – I (PSPE 01)	Course Code	List of Program Elective Course – II (PSPE 02)
PSPE 01.1	Reactive Power Control and Management.	PSPE 02.1	Dynamics of System Theory.
PSPE 01.2	Energy Auditing and Management.	PSPE 02.2	Pulse Width Modulation for PE Converters.
PSPE 01.3	Smart Grids Technologies.	PSPE 02.3	High Power Converters.
PSPE 01.4	FACTS and Custom Power Devices.	PSPE 02.4	Advanced Micro- Controller Based Systems .

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Scheme of Instruction- (CBCS) Effective from the Academic Year 2023-24

Specialization: M. Tech (Power Systems)

M.Tech (Power Systems) - II Semester

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	PSPC 04	Advanced Power System Protection.	4	0	0	4	4	40	60	100
PCC	PSPC 05	Electrical Power Distribution Systems.	4	0	0	4	4	40	60	100
PCC	PSPC 06	Wind and Solar Energy Systems.	3	1	0	4	3	40	60	100
PEC	PSPE 03	Program Elective III.	3	1	0	4	3	40	60	100
PEC	PSPE 04	Program Elective IV.	3	1	0	4	3	40	60	100
PCL	PSCP 03	Power System Protection Lab.	0	0	3	3	1.5	40	60	100
PCL	PSCP 04	Wind and Solar Energy Systems Lab.	0	0	3	3	1.5	40	60	100
VAC	PSVAC01	Electrical Safety and Management.	3	1	0	4	3	40	60	100
MINI	PSMPS00	Mini Project with Seminar.	1	0	2	3	2	40	60	100
Total			**21**	**04**	**08**	**33**	**25**	**360**	**540**	**900**

Course Code	List of Program Elective Course – III (PSPE 03)	Course Code	List of Program Elective Course – IV (PSPE 04)
PSPE 03.1	Power Quality Issues and Mitigation	PSPE 04.1	Electric and Hybrid Vehicles.
PSPE 03.2	Restructured Power Systems.	PSPE 04.2	Industrial Power Electronics.
PSPE 03.3	Power Apparatus and Design.	PSPE 04.3	SCADA System and Applications.
PSPE 03.4	Advanced Digital Signal Processing.	PSPE 04.4	Embedded Systems.

Instruction: The students can undergo Open Elective Course work (12 week's duration) from the day of commencement of Second semester class work through online (MOOCS)/ NPTEL and can select the subjects that are not covered in the Curriculum. However, the obtained pass certificate should be submitted on or before the last working day of the III - Semester Course work without fail and result will be reflected in III - Semester Marks MEMO. Otherwise, your results will be reflected in supplementary mode if certificate is submitted after last working day of III - Semester.

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Scheme of Instruction- (CBCS) Effective from the Academic Year 2023-24

Specialization: M. Tech (Power Systems)

M.Tech (Power Systems) - III Semester

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation	
			Lecture	Tutorial	Practical	Total		Semester End Examination Marks	Total
OEC	PGOE01	Open Elective Course (MOOCS).	3	0	0	3	3	100	100
PCC	PSPD01	Dissertation Project Work Phase - I	0	0	24	24	12	100	100
Total			**3**	**0**	**24**	**27**	**15**	**200**	**200**

Instruction:

1. The Students can undergo Open Elective Course work (12 week's duration) from the day of commencement of Second semester class work through online (MOOCS)/ NPTEL and can select the subjects that are not covered in the Curriculum. However, the obtained pass certificate should be submitted on or before the last working day of the III - Semester Course work without fail and result will be reflected in III - Semester Marks MEMO. Otherwise, your results will be reflected in supplementary mode if certificate is submitted after last working day of III-Semester.
2. Evaluation of Dissertation Phase – I work: Review after 6 – 8 weeks (20 marks), Continuous Guide Evaluation (40 marks) and End Semester Evaluation (40 marks). – Total Marls: 100 marks.

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Scheme of Instruction- (CBCS) Effective from the Academic Year 2023-24

Specialization: M. Tech (Power Systems)

M.Tech (Power Systems) - IV Semester

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	PSPD02	Dissertation Project Work Phase – II and Viva-Voce	0	0	32	32	16	60	40	100
Total			**0**	**0**	**32**	**32**	**16**	**60**	**40**	**100**

Instruction:

1. Evaluation of Dissertation Project work Phase – II : Review after 8-10 weeks (20 marks) and Continuous Guide Evaluation (40 marks) and End Semester Examination (40 marks).
2. Student must submit their project work on or before the last working day/Instruction day of the IV Semester of the Program. Otherwise Rs. 1,000/- penalty for late submission will be levied to extend submission up to three months. In case of failure of the said condition the penalty amount will be doubled up to the completion of the course.



M.TECH – I SEMESTER

SYLLABUS

(R23 REGULATIONS)

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING
M.TECH: POWER SYSTEMS - FIRST SEMESTER - SYLLABUS

PSPC 01: COMPUTER METHODS IN POWER SYSTEMS

Instruction Hours/week: 4(L) **Credits: 4**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Power System Network Matrices: Graphs, Incidence matrices, Primitive network, formation of Bus admittance matrix by singular transformations, direct inspection method for determination of Y_{BUS}, Formation of Bus impedance matrix - Addition of a branch and Addition of a link. Simple problems.

UNIT-II

Load Flow Studies: Load flow problem, Gauss-Seidel method, Newton Raphson method, Decoupled and Fast decoupled load flow methods, Comparison of load flow methods.

UNIT-III

Fault Analysis: Short circuit (Symmetrical - 3-phase fault, Unsymmetrical - SLG, LL, LLG faults) calculations using Bus impedance matrix, Fault Impedance Matrix, Fault Currents and Fault Voltages.

UNIT-IV

Power System Security Analysis: Factors affecting Power system security, Security state diagram, contingency analysis - Sensitivity factors - Generator Outage Shift factor (GOSF) and Line Outage Shift Factor (LOSF).

UNIT-V

Voltage Stability: Voltage collapse and prevention of voltage collapse, Voltage stability analysis - P-V curve method, V-Q curve method and Modal analysis.

Text Books:

1. Computer methods in Power System Analysis by Stagg and El Abiad, Mc.Graw Hill Book Company.
2. L.P. Singh , “Advanced Power System Analysis and Dynamics”, New Age International, 2006
3. A.J. Wood, “Power generation, operation and control”, John Wiley, 1994.

References:

1. J.J. Grainger &W.D. Stevenson, “Power system analysis ”, McGraw Hill ,2003
2. Arthur. R. Bergen & Vijay Vittal , “Power System Analysis” ,Pearson , 2000
3. P.M. Anderson, “Faulted power system analysis” , IEEE Press , 1995

Course outcomes-

Students will be able to:

1. Find the bus admittance and bus impedance matrices of the given power system network.
2. Perform power flow studies using various load flow methods.
3. Calculate fault currents and voltages during fault conditions.
4. Assess the power system security using GOSF and LOSF methods.
5. Analyze voltage stability using PV, QV and Modal Analysis.

PSPC 02- INTERCONNECTED POWER SYSTEM OPERATION AND CONTROL

Instruction Hours/week: 4(L) **Credits: 4**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Unit Commitment: Introduction, constraints in unit commitment, thermal unit constraints, unit commitment solution methods, priority-list methods, Dynamic-Programming solution, forward DP Approach, Lagrange relaxation solution.

State Estimation: Power System State Estimation, Weighted Least Square Estimation, State Estimation of an AC Network.

UNIT-II

Load Frequency Control: Necessity of keeping frequency constant, definition of control area, single area control, block diagram representation of an isolated power system, steady state analysis, dynamic response, uncontrolled case, load frequency control of 2-area system, uncontrolled case and controlled case, tie-line bias control

UNIT-III

Generation with Limited Energy Supply: Introduction, take-or-pay fuel supply contract, composite generation production cost function, solution by gradient search techniques, hard limits and slack variables, fuel scheduling by linear programming

UNIT-IV

Hydro thermal Coordination: Introduction, long range hydro scheduling, short-range hydro-scheduling, hydroelectric plant models, scheduling problems, types of scheduling problems, scheduling energy, the short term hydro-thermal scheduling problem, short term hydro scheduling, gradient approach, pumped storage hydro plants, dynamic programming solution to the hydrothermal scheduling problem.

UNIT-V

Interchange of Power and Energy: Introduction, economy interchange between interconnected utilities, inter-utility economy energy evaluation, interchange evaluation with unit commitment, multiple-utility interchange transactions, types of interchange, capacity interchange, diversity interchange, emergency power interchange, inadvertent power exchange, power pools, transmission effects and issues, problems

Text Books:

1. Power Generation Operation and Control, Allen J. Wood, Bruce F.Wollenberg, 2nd ed. John Wiley & Sons Inc. 2006.
2. Electrical Energy Systems Theory, O.I.Elgerd, Tata McGraw-Hill Publishing Company Ltd, 2nd edition.
3. Modern Power System Analysis, I.J. Nagrath & D.P. Kothari, TMH,3rd edition, 9th reprint, 2007

Course outcomes-

Students will be able to:

1. Acquire knowledge on unit commitment, load frequency control, optimum operation, scheduling and coordination of hydrothermal plants, economic generation and power and energy interchange.
2. Solve unit commitment, load frequency control, hydrothermal and fuel scheduling and economy interchange problems using various solution methods.
3. Select and apply appropriate methods to operate inter connected power systems most economically and at constant frequency by optimum utilization of fuels at different loads.

PSPC 03: AI APPLICATIONS TO POWER SYSTEMS

Instruction Hours/week: 4(L) **Credits: 4**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Introduction to AI: Definition, Applications, Components of an AI program, production system. Problem Characteristics, Overview of searching techniques. Knowledge representation: knowledge representation issues; and overview, Representing knowledge using rules; procedural versus declarative knowledge, Logic programming, forward versus backward reasoning, matching, Control Knowledge.

UNIT-II

Artificial Neural Networks: Biological Neuron, Neural Net, Use of neural nets, applications, perception, idea of single layer and multilayer neural nets, Back propagation, Hopfield nets, supervised and unsupervised learning.

UNIT-III

Introduction to classical sets – properties, Operations and relations; Fuzzy sets, Membership, Operations, Properties, Fuzzy relations, Cardinalities, Membership functions.
Fuzzy logic system components: Fuzzification, Inference engine, Defuzzification to crisp sets – Defuzzification methods.

UNIT-IV

Genetic Algorithms – Genetic Algorithm versus Conventional Optimization Techniques, Genetic representations and Selection Mechanisms; Genetic Operators – Different types of crossover and mutation operators.
Particle Swarm Optimization - Particle Swarm Optimization Bird flocking and fish Schooling, anatomy of a particle, equations based on velocity and positions, PSO topologies, control parameters.

UNIT-V

Applications of AI Techniques: ANN – Load flow, Economic load Dispatch, Load forecasting. Fuzzy Logic – Single area and two area load frequency control, Speed control of DC Motor. GA and PSO – GA and PSO algorithms for solving ELD problems.

Text Books:

1. Artificial Intelligence Techniques in Power Systems (Energy Engineering), by Kelvin Warwick, Arthur Ekwue, Rag Aggarwal, 1997.
2. AI Application Areas n Power Systems, Iraj Dabbaghchi, American Electric Power Richard D. Christie, Gary W. Rosenwald and Chen – Ching Liu, University of Washington.
3. J M Zurada , "An Introduction to ANN", Jaico Publishing House
4. Timothy Ross, "Fuzzy Logic with Engg. Applications", McGraw. Hill
5. Golding, "Genetic Algorithms", Addison-Wesley Publishing Com
6. Rajasekharan and Pai, "Neural Networks, Fuzzy logic – Genetic Algorithms –Synthesis and Applications" PHI Publications.
7. Xin-She Yang, "Recent Advances in Swarm Intelligence and Evolutionary Computation", Springer International Publishing, Switzerland, 2015.

Course outcomes-

Students will be able to:

1. Learn the concepts of artificial neural networks and Fuzzy Logic.
2. Acquire the knowledge of GA and PSO.
3. Use the Soft Computing Techniques for Power System problems.
4. Apply GA and PSO to Power System optimization problems.

PROGRAM ELECTIVE- I

PSPE 01.1: REACTIVE POWER CONTROL AND MANAGEMENT

Instruction Hours/week: 3(L) & 1(T) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

The Steady State Reactive Power Control in Electrical Transmission Systems: Basics of Reactive Power Control, uncompensated transmission lines, compensated transmission lines, passive shunt compensation, series compensation

UNIT-II

Reactive Power Compensation and The Dynamic Performance of Transmission System: Introduction, passive shunt compensation, Static compensators, Synchronous condenser, characteristics, comparison of compensations.

UNIT-III

Principles of Static Compensators: Introduction, Compensator applications, properties and types of static compensators, Thyristor Controlled Reactor (TCR) and types of compensation, Thyristor Switched Capacitor (TSC), SVC Schemes/Configurations, Fixed Capacitance (FC).

UNIT-IV

Demand Side Management: Load patterns – basic methods load shaping – power tariffs- KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels.
Distribution side Reactive power Management: System losses –loss reduction methods – examples – Reactive power planning – objectives –Economics Planning capacitor placement – retrofitting of capacitor banks.

UNIT-V

User Side Reactive Power Management: KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors – types of available capacitor, characteristics and Limitations.

Reactive power management in electric traction systems and arc furnaces: Typical layout of traction systems – reactive power control requirements – distribution transformers- Electric arc furnaces – basic operations- furnaces transformer –filter requirements –remedial measures –power factor of an arc furnace.

Text Books:

1. Reactive Power Control in Electrical Power Systems by T. J. E. Miller
2. Reactive power Management by D.M. Tagare, Tata McGraw Hill,2004. (Units IV to V)

Course outcomes-

Students will be able to:

1. Understand the significance of reactive power control in power system and principles of various controllers.
2. To know about the importance of reactive power management and various management techniques employed in power system networks

PSPE 01.2: ENERGY AUDITING AND MANAGEMENT

Instruction Hours/week: 3(L) & 1(T) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

System approach and End use approach to efficient use of Electricity, Electricity tariff types.
Energy auditing: Types and objectives - audit instruments, ECO assessment and Economic methods, Specific energy analysis-Minimum energy paths-consumption models- Case study

UNIT-II

Electric motors-Energy efficient controls and starting efficiency-Motor Efficiency and Load Analysis-Energy efficient /high efficient Motors-Case study, Load Matching and selection of motors Variable speed drives; Pumps and Fans-Efficient Control strategies- Optimal selection and sizing-Optimal operation and Storage-Case study, Transformer Loading/Efficiency analysis, Feeder/cable loss evaluation- case study

UNIT-III

Reactive Power Management-Capacitor Sizing-Degree of Compensation-Capacitor Losses-Location-Placement-Maintenance -Case study, Peak Demand controls- Methodologies-Types of Industrial Loads-Optimal Load scheduling-case study, Lighting- Energy efficient light sources-Energy conservation in Lighting Schemes, Electronic ballast-Power quality issues-Luminaries, case study

UNIT-IV

Cogeneration-Types and Schemes-Optimal operation of cogeneration plants-case study, Electric loads of Air conditioning & Refrigeration, Energy conservation measures- Cool storage Types-Optimal operation case study

UNIT-V

Electric water heating-Geysers-Solar Water Heaters, Power Consumption in Compressors, Energy conservation measures, Electrolytic Process, Computer Controls- software-EMS

Text Books:

1. Anthony J. Pansini, Kenneth D. Smalling, .Guide to Electric Load Management., Pennwell Pub; (1998)
2. Howard E. Jordan, .Energy-Efficient Electric Motors and Their Applications., Plenum Pub Corp; 2ndedition (1994)
3. Giovanni Petrecca, .Industrial Energy Management: Principles and Applications., The Kluwerinternational series -207,1999

Course outcomes-

Students will be able to:

1. Acquire the background required for engineers to meet the role of energy managers and to acquire the skills and techniques required to implement energy management
2. Identify and quantify the energy intensive business activities in an organization
3. Able to perform Basic Energy Audit in an Organization

PSPE 01.3: SMART GRID TECHNOLOGIES

Instruction Hours/week: 3(L) & 1(T) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities and barriers of smart grid, difference between conventional and smart grid, Concept of Robust & Self Healing Grid Present development & International policies in Smart Grid, Case study of Smart Grid.

UNIT-II

Smart Grid Technologies: Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation, Geographic Information System (GIS), Phase Measurement Unit (PMU).

UNIT-III

Microgrids and Distributed energy Resources: Concepts of Microgrid, need and applications of Microgrid, formation of Microgrid, Issues of interconnection, protection & control of micro-grid, plastic and organic solar cells, Thin film solar cells, Variable speed wind generation, fuel cells, micro-turbines, Captive power plants, Integration of renewable energy sources.

UNIT-IV

Power Quality Management in Smart Grid: Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

UNIT-V

Information and Communication technology for smart grid: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area, Network (NAN), Wide Area Network (WAN), Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing & Cyber Security for Smart Grid, Broadband over Power line (BPL), IP based protocols

Text Books:

1. Ali Keyhani, “Design of smart power grid renewable energy systems”, Wiley IEEE, 2011
2. Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press, 2009
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, “Smart Grid: Technology and Applications”, Wiley 2012
4. Stuart Borlase, “Smart Grid: Infrastructure, Technology and solutions “CRC Press.
5. A. G. Phadke, “Synchronized Phasor Measurement and their Applications”, Springer.
6. S. Chowdary, S.P. Chowdhury, P. Crossley, “Microgrids and Active Distribution Networks”, Institution of Engineering and Technology.
7. A. Keyhani, M.N. Marwali, M. Dal, “Integration of Green and Renewable Energy in Electric Power Systems”, Wiley.

Course Outcomes-

Students will be able to:

1. Appreciate the difference between smart grid & conventional grid.
2. Apply smart metering concepts to industrial and commercial installations.
3. Formulate solutions in the areas of smart substations, distributed generation and wide area measurements.
4. Come up with smart grid solutions using modern communication technologies.

PSPE 01.4: FACTS AND CUSTOM POWER DEVICES

Instruction Hours/week: 3(L) & 1(T) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Transmission line connections, Power flow in parallel lines, Mesh systems, Stability considerations, Relative importance of controllable parameters, Basic types of FACTS controllers, Shunt controllers, Series controllers, Combined shunt and series controllers, Benefits of FACTS.

UNIT-II

Static versus passive VAR compensator, Static shunt compensators: Static VAR Compensation (SVC) and Static Synchronous Compensation (STATCOM), Operation of Thyristor- Switched Capacitor (TSC), Thyristor Controlled Reactor (TCR) and Static Synchronous Compensation (STATCOM), Comparison between SVC and STATCOM.

UNIT-III

Static series compensation: Thyristor Switched Series Capacitor (TSSC), Static Synchronous Series Compensator (SSSC) – Thyristor Controlled Voltage Reactor (TCVR) and Thyristor Controlled Phase Angle Reactor (TCPAR) principle of Operation, Gate-Controlled Series Capacitor (GCSC), Thyristor Switched Series Capacitor (TSSC) and Static Synchronous series compensators operation (SSSC).

UNIT-IV

Sub Synchronous Resonance (SSR) and its damping, Unified Power Flow Controller Circuit, Arrangement Operation of Unified Power Flow Controller (UPFC), Introduction to interline power flow controller (IPFC).

UNIT-V

Power quality problems in distribution systems, passive filters, active filtering – shunt , series and hybrid, Voltage swells , sags, flicker, unbalance and mitigation of these problems by power line conditioners, IEEE standards on power quality.

Text Books:

1. N.G. Hingorani, L. Gyugyi, “Understanding FACTS: Concepts and Technology of Flexible
2. Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International Publishers, 2007
3. X P Zhang, C Rehtanz, B Pal, “Flexible AC Transmission Systems- Modeling and Control”, Springer Verlag, Berlin, 2006
4. AC Transmission Systems”, IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
5. K.S. Suresh kumar, S. Ashok, “FACTS Controllers & Applications”, E-book edition, Nalanda Digital Library, NIT Calicut,2003

Course outcomes-

Students will be able to:

1. Acquire knowledge about the fundamental principles of Passive and Active Reactive Power Compensation Schemes at Transmission and Distribution level in Power Systems.
2. Learn various Static VAR Compensation Schemes like Thyristor/GTO Controlled Reactive Power Systems, PWM_Inverter based Reactive Power Systems and their controls.
3. To develop analytical modeling skills needed for modeling and analysis of such Static VAR Systems.

PROGRAM ELECTIVE- II

PSPE 02.1: DYNAMICS OF SYSTEM THEORY

Instruction Hours/week: 3(L) & 1(T) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Controllers: Introduction to controllers – Need for controllers – Types of Controllers – Proportional, Integral and Derivative Controllers – Transfer function of controllers - PI, PD, PID Controllers – Design of controllers using frequency domain analysis – Controllers applications in Systems.

UNIT-II

State Space Analysis: Mathematical Modeling of Physical systems, solutions of state equations – Homogeneous and Non-homogeneous – state transmission matrix (STM) – Computation of STM, Controllability and observability time invariant linear systems.

UNIT-III

Nonlinear Systems - Different techniques of linearizing non-linear systems – behaviour of nonlinear systems - Common physical non linearities - Describing functions for various types of non-linearities – describing function analysis of nonlinear control systems – singular points of non-linear systems.

UNIT-IV

Pole placement technique: Pole placement technique by state feedback for linear SISO time, invariant system – Theory of high-gain feedback-advantages – Pole placement technique along with high-gain feedback control – state observers – Full order and reduced order observer.

UNIT-V

Stability Analysis: Concept of Stability, Definitions in the sense of Lyapunov, Lyapunov stability theorem - Different methods of constructing Liapunov functions for linear and non-linear continuous systems.

Text Books:

1. Gopal, M., „Modern Control Systems Theory", Wiley Eastern Ltd., 1993.
2. Ogata, K., „Modern Control Engineering", Prentice Hall of India, 4th edition , 2003.
3. Kuo, B.C., „Automatic Control Systems", Prentice Hall of India, 1999. Thomas Kailath, "Linear Systems", Prentice Hall Inc., Englewood Cliffs, N.J. 1980.

Course outcomes-

Students will be able to:

1. To learn linear system modeling, analysis and design so as to obtain the ability to apply the same to engineering problems in a global perspective
2. Design observers and controllers for linear systems
3. Acquire Knowledge of continuous time linear systems modeling, analysis and design.
4. Know the stability analysis using Lyapunov methods

PSPE 02.2: PULSE WIDTH MODULATION FOR PE CONVERTERS

Instruction Hours/week: 3(L) & 1(T) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Fundamental Concepts of PWM: Fundamental Concepts of PWM, Evaluation of PWM Schemes, Double Fourier Integral Analysis of a Two-Level Pulse Width- Modulated Waveform, Naturally Sampled Pulse Width Modulation Sine-Sawtooth Modulation, Sine-Triangle Modulation, PWM Analysis by Duty Cycle Variation, Sine-Sawtooth Modulation, Sine-Triangle Modulation

UNIT-II

Regular Sampled Pulse Width Modulation: Fundamental Concepts of PWM, Evaluation of PWM Schemes, Sawtooth Carrier Regular Sampled PWM, Symmetrical Regular Sampled PWM, Asymmetrical Regular Sampled PWM, direct Modulation

UNIT-III

Modulation of One Inverter Phase Leg: Double Fourier Integral Analysis of a Two-Level Pulse Width- Modulated Waveform, Naturally Sampled Pulse Width Modulation, PWM Analysis by Duty Cycle Variation, Regular Sampled Pulse Width Modulation, Integer versus Non-Integer Frequency Ratios

UNIT-IV

Modulation of Single-Phase Voltage Source Inverters: Topology of a Single-Phase Inverter Three-Level Modulation of a Single-Phase Inverter Analytical Calculation of Harmonic Side band Modulation, Switched Pulse Position, Continuous Modulation, Discontinuous Modulation Losses, Switched Pulse Sequence, Discontinuous PWM

UNIT-V

Zero Space Vector Placement Modulation Strategies: Space Vector Modulation, Principles of Space Vector Modulation, SVM Compared to Regular Sampled PWM, Phase Leg References for Space Vector Modulation Naturally Sampled SVM, Analytical Solution for SVM, Harmonic Losses for SVM, Placement of the Zero Space Vector, Discontinuous Modulation, 1200 Discontinuous Modulation, 600 and 300 Discontinuous Modulation

Text Books:

1. D. Grahame Holmes, Thomas A. Lipo, “Pulse width modulation of Power Converter: Principles and Practice”, John Wiley & Sons, 03-Oct-2003
2. J Ned Mohan, Undeland, Robbins, “Power electronics: converters, applications, and design” (John wiley and Sons 2003)

Course outcomes-

Students will be able to:

1. Learn different types of PWM schemes and their applications
2. Asses the THD for different types of PWM schemes
3. Choose suitable PWM scheme for different topologies of power electronic circuits

PSPE 02.3: HIGH POWER CONVERTERS

Instruction Hours/week: 3(L) & 1(T) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

High-Power Switching Devices: Gate Turn-Off (GTO) Thyristor, Gate-Commutated Thyristor (GCT), Insulated Gate Bipolar Transistor (IGBT), Other Switching Devices, Operation of Series-Connected Devices Main Causes of Voltage Unbalance, Voltage Equalization for GCTs, Voltage Equalization for IGBTs

UNIT-II

Two-Level Voltage Source Inverters: Introduction, Sinusoidal PWM, Modulation Schemes, Harmonic Content Over-modulation, Third Harmonic Injection PWM, Space Vector Modulation Switching States, Space Vectors, Dwell Time Calculation, Modulation Index Switching Sequence, Spectrum Analysis, Even-Order Harmonic Elimination, Discontinuous Space Vector Modulation

UNIT-III

Cascaded H-Bridge Multilevel Inverters: Introduction, H-Bridge Inverter Bipolar Pulse-Width Modulation, Unipolar Pulse-Width Modulation, Multilevel Inverter Topologies, CHB Inverter with Equal dc Voltage, H-Bridges with Unequal dc Voltages, Carrier Based PWM Schemes, PWM Schemes, Staircase Modulation

UNIT-IV

A **Diode-Clamped Multilevel Inverters:** Three-Level Inverter, Converter Configuration, Switching State, Phase-Shifted Multicarrier Modulation, Level-Shifted Multicarrier Modulation, Comparison Between Phase- and Level-Shifted Commutation, Space Vector Modulation, Inverter Output Waveforms and Harmonic Content, Even-Order Harmonic Elimination, Neutral-Point Voltage Control, Causes of Neutral-Point Voltage Deviation, Effect of Motoring and Regenerative Operation.

UNIT-V

Other Space Vector Modulation Algorithms: Discontinuous Space Vector Modulation, SVM Based on Two-Level Algorithm, High-Level Diode-Clamped Inverters, Four- and Five-Level Diode-Clamped Inverters, Carrier-Based PWM, NPC/H-Bridge Inverter: Inverter Topology, Modulation Scheme, Waveforms and Harmonic Content

Text Books:

1. Bin Wu," High Power Converters and AC Drives (IEEE Press 2008)
2. By Dorian O Neacsu, "Power Switching Converters: Medium and High Power"
3. Handbook on Energy Audit and Environment Management, Y P Abbi and Shashank Jain, TERI,2006
4. Handbook of Energy Audits Albert Thumann, William J. Younger, Terry Niehus, 2009

Course outcomes-

Students will be able to:

1. Learn the characteristics of GTOs, IGBTs and use them in practical systems
2. Knowledge of working of multi-level VSIs, DC-DC switched mode converters, cyclo-converters and PWM techniques and the ability to use them properly
3. Acquire knowledge of power conditioners and their applications
4. Ability to design power circuit and protection circuit of PSDs and converters.

PSPE 02.4: MICRO-CONTROLLER AND APPLICATIONS

Instruction Hours/week: 3(L) & 1(T) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Overview of Architecture & Microcontroller Resources: Architecture of a microcontroller – Microcontroller resources – Resources in advanced and next generation microcontrollers – 8051 microcontroller – Internal and External memories – Counters and Timers – Synchronous serial-cum asynchronous serial communication - Interrupts.

UNIT-II

8051- Microcontrollers Instruction Set: Basic assembly language programming – Data transfer instructions – Data and Bit manipulation instructions – Arithmetic instructions – Instructions for Logical operations on the test among the Registers, Internal RAM, and SFRs – Program flow control instructions – Interrupt control flow.

UNIT-III

Real Time Control Interrupts: Interrupt handling structure of an MCU – Interrupt Latency and Interrupt deadline – Multiple sources of the interrupts – non-maskable interrupt sources – Enabling or disabling of the sources – Polling to determine the interrupt source and assignment of the priorities among them – Interrupt structure in Intel 8051. TIMERS: Programmable Timers in the MCU's – Free running counter and real time control – Interrupt interval and density constraints.

UNIT-IV

Systems Design Digital and Analog Interfacing Methods: Switch, Keypad and Keyboard interfacings – LED and Array of LEDs – Keyboard-cum-Display controller (8279) – Alphanumeric Devices – Display Systems and its interfaces – Printer interfaces – Programmable instruments interface using IEEE Bus – Interfacing with the Flash Memory – Interfaces – Interfacing to High Power Devices – Analog input interfacing

UNIT-V

Real Time Operating System for Microcontrollers: Real Time operating system – RTOS of Keil (RTX51) – Use of RTOS in Design – Software development tools for Microcontrollers. 16-BIT MICROCONTROLLERS: Hardware – Memory map in Intel 80196 family MCU system – IO ports – Programmable Timers and High-speed outputs and input captures – Interrupts – instructions. ARM 32 Bit MCUs: Introduction to 16/32 Bit processors – ARM architecture and organization – ARM / Thumb programming model – ARM / Thumb instruction set – Development tools.

Text Books:

1. Raj Kamal, "Microcontrollers Architecture, Programming, Interfacing and System Design" – Pearson Education, 2005.
2. Mazidi and Mazidi, "The 8051 Microcontroller and Embedded Systems" – PHI, 2000.
3. Microprocessors and Microcontrollers, Architecture, Programming and System Design, Krishna Kant, PHI Learning PVT. Ltd.
4. Steve Furber "Arm system-on-chip Architechture",2nd edition, Pearson publication.

References:

1. A.V. Deshmuk, "Microcontrollers (Theory & Applications)" – WTMH, 2005.
2. John B. Peatman, "Design with PIC Microcontrollers" – Pearson Education, 2005.
3. Microcontroller Programming, Julio Sanchez, Maria P. Canton, CRC Press.
4. The 8051 Microcontroller, Ayala, Cengage Learning.
5. Microprocessors, Nilesh B. Bahadure, PHI Learning PVT. Ltd.

Course outcomes-

Students will be able to:

1. Distinguish types of computers & microcontrollers,
2. Use 8-Bit, 16- Bit & 32-Bit advanced Microcontrollers.
3. Develop Real time Applications of Microcontrollers & Demonstrate RTOS for Microcontrollers.
4. Translate Hardware applications using Microcontrollers.

PSCP 01: COMPUTER METHODS IN POWER SYSTEMS LAB

Instruction Hours/week: 3(P) **Credits: 1.5**
Sessional Marks: 40 **Semester-End Examination: 60**

S.No	EXPERIMENTS
1	Formation of Incidence Matrices.
2	Formation of Ybus by using Singular Transformation method.
3	Formation of Ybus by using Direct Inspection method.
4	Formation of Bus Impedance Matrix.
5	Load Flow Analysis by using Gauss-Siedel Method.
6	Load Flow Analysis by using Newton-Raphson Method.
7	Fault analysis for Single line to Ground fault.
8	Fault analysis for Three phase to Ground fault.
9	Generation outage Sensitivity Factor.
10	Line Outage Sensitivity Factor.
11	PV Curve.
12	QV Curve.
13	Load Flow Analysis by using Decoupled Methods.

Note: Any **Ten** Experiments are to be conducted.

PSCP 02: AI APPLICATIONS TO POWER SYSTEMS LAB

Instruction Hours/week: 3(P) **Credits: 1.5**
Sessional Marks: 40 **Semester-End Examination: 60**

S.No	EXPERIMENTS
1	Program to Generate XOR Function using Mc-culloch pits Neuron Model
2	Program to Generate Different Activation Function of Neuron Model
3	Load flow analysis using Neural Network
4	State Estimation Using Neural Network
5	Contingency Analysis Using Neural Network
6	Speed Control of DC Motor Using Fuzzy Logic.
7	Single Area Load Frequency Control using Fuzzy Logic Controller.
8	Two Area Load Frequency Control using Fuzzy Logic Controller.
9	Maximization of SinX function using Genetic Algorithm.
10	Economic Load Dispatch solution without system losses using Genetic Algorithm
11	Economic Load Dispatch solution considering system losses using Genetic Algorithm
12	Economic Load Dispatch Solution using PSO

Note: Any **Ten** Experiments are to be conducted.

PGMC 01: RESEARCH METHODOLOGY AND IPR

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT-II

Effective literature studies approaches, analysis, Plagiarism, Research ethics.

UNIT-III

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT-IV

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT. Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT-V

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & Engineering students”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2nd Edition , “Research Methodology: A Step by Step Guide for beginners”
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
5. Mayall , “Industrial Design”, McGraw Hill, 1992.
6. Niebel , “Product Design”, McGraw Hill, 1974.
7. Asimov , “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course outcomes-

At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understand that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.



M.TECH – II SEMESTER

SYLLABUS

(R23 REGULATIONS)

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

M.TECH: POWER SYSTEMS - SECOND SEMESTER - SYLLABUS

PSPC 04: ADVANCED POWER SYSTEM PROTECTION

Instruction Hours/week: 4(L) **Credits: 4**

Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

General philosophy of protection - Classification and Characteristic function of various protective relays, basic relay elements and relay terminology - Development of relaying scheme

Numerical Protection: Introduction - Block diagram of numerical relay - Sampling theorem - Correlation with a reference wave - Least Error Squared (LES) technique

UNIT-II

Static Relays: Fundamentals of static relays, Basic Block diagram and principle, Advantages of Static Relays, Types of static relays, Static Over-current relays, Differential relays, Percentage Differential relays, distance relays, characteristics of static relays.

UNIT-III

Amplitude Comparators: Circulating current type and opposed voltage type, rectifier bridge comparators, Instantaneous comparators.

Phase Comparators: Coincidence circuit type, block spike phase comparator, techniques to measure the period of coincidence, Integrating type, Rectifier Phase comparators.

UNIT-IV

Digital Protection of power system apparatus – protection of generators – Transformer protection – magnetizing inrush current – Application and connection of transformer differential relays – transformer over current protection Bus bar protection - line protection - distance protection–long EHV line protection - Power line carrier protection.

UNIT-V

Microprocessor Based Protective Relays: Over current relays – Impedance relays – Directional relay – Reactance relay (Block diagram and flowchart approach).

Basic elements of Digital Protection: Historical Developments in digital protection, performance and operational characteristics of digital protection, basic structure of digital relays, components of digital relay, signal conditioning subsystem, conversion subsystem, digital relay subsystem

Text Books:

1. A.G. Phadke and J. S. Thorp, “Computer Relaying for Power Systems”, Wiley/Research studies Press, 2009
2. A.T. Johns and S. K. Salman, “Digital Protection of Power Systems”, IEEE Press,1999
3. Gerhard Zeigler, “Numerical Distance Protection”, Siemens Publicis Corporate Publishing, 2006
4. S.R.Bhide “Digital Power System Protection” PHI Learning Pvt.Ltd.2014
5. Electrical Power Systems – C.L. Wadwa
6. Lewis Blackburn, J., ‘Protective Relaying – Principles and Applications’, Marcel Dekkar, INC, New York, 2006.
7. Power System Protection with Static Relays – by TSM Rao, TMH.
8. Power system protection & switchgear by Badri Ram & D N viswakarma, TMH.

Course outcomes-

Students will be able to:

1. Learn the importance of static Relays
2. Apply appropriate comparator
3. Learn about digital Protection

PSPC 05: ELECTRICAL POWER DISTRIBUTION SYSTEMS

Instruction Hours/week: 4(L) **Credits: 4**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Distribution of Power, Management, Power Loads, Power System Loading, Short-term & Long-term Load Forecasting, Technological Forecasting. Urban/Rural Distribution, Energy Management and tariffs – Revenue improvement – issues in multi-year tariff and availability based tariff.

UNIT-II

Power Factor Correction, Calculation of Optimum Number of Switches, Capacitors, Optimum Switching Device Placement in Radial Distribution Systems, Sectionalizing Switches – Types, Benefits, Bellman's Optimality Principle.

UNIT-III

Distribution Management System (D.M.S.)-Need, advantages, functions, Distribution Automation: Definition, Restoration / Reconfiguration of Distribution Network-Different Methods and Constraints. Interconnection of Distribution, Control & Communication Systems, Remote Terminal Units, Energy efficiency in electrical distribution & Monitoring

UNIT-IV

SCADA: Introduction, Block Diagram, SCADA Applied To Distribution Automation. Common Functions of SCADA, RTU and Data Communication, Communication media and protocols for Distribution systems- IEC 61850 and IEEE 802.3 standards, Advantages of Distribution Automation through SCADA

UNIT-V

Remote Metering-Automatic Meter Reading and its implementation, Maintenance of Automated Distribution Systems, Difficulties in Implementing Distribution Automation in Actual Practice. AI techniques applied to Distribution Automation.

Text Books:

1. M.K. Khedkar, G.M. Dhole, "A Text Book of Electrical power Distribution Automation", University Science Press, New Delhi
2. A.S. Pabla, "Electric Power Distribution", Tata McGraw Hill Publishing Co. Ltd., Fourth Edition.
3. Anthony J Panseni, "Electrical Distribution Engineering", CRC Press.
4. James Momoh, "Electric Power Distribution, automation, protection & control", CRC Press

Course outcomes-

Students will be able to:

1. Knowledge of power distribution system
2. Study of Distribution automation and its application in practice
3. To learn SCADA system

PSPC 06: WIND AND SOLAR ENERGY SYSTEMS

Instruction Hours/week: 3(L) & 1(T) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Renewable Energy System: Introduction to Renewable Energy System**,** Sources of Renewable Energy System**,** Solar and Wind Power in Power System**:** History and current status, characteristics of solar and wind power generation, Network Integration issues.

UNIT-II

Generators and power electronics for wind turbines: Power in wind, availability, Types of wind turbines, Construction features of wind turbines, rotor design considerations, power extraction by turbine, Integration of wind energy converters to electrical networks, applications of wind energy.

UNIT-III

Solar Radiation and its measurements: Introduction, Solar radiation and its measurements, Estimation of average solar radiation.
Solar Energy Collectors: Introduction, Types Characteristics and principles of different types of collectors and their efficiencies, Advantages and Disadvantages

UNIT-IV

Solar Energy Storage: Introduction, Methods of Energy Storage Systems, Solar Ponds. Pumped Energy Storage, Compressed Energy Storage, Storage Batteries.
Applications of Solar Energy: Introduction, Solar Photo-Voltaic cells, PV array and PV module, Maximum power point tracking system.

UNIT-V

Renewable energy integrated with Grid: Introduction, Integration of Wind Energy and solar energy with Power Systems Grid, Impact on Power Quality, Power Electronics and solutions System modeling, Technologies.

Text Books:

1. Thomas Ackermann, Editor, "Wind power in Power Systems", John Willy and sons ltd.2005
2. G.D.Rai "Non-Conventional Energy sources", Khanna Publishers, Newdelhi,1999
3. Patel M.R "Wind and solar Power Systems, Design, Analysis and Operation", CRC Press, New York, Second Edition, 2005.
4. Siegfried Heier, "Grid integration of wind energy conversion systems", John Willy and sons ltd., 2006.
5. K. Sukhatme and S.P. Sukhatme, "Solar Energy". Tata MacGraw Hill, Second Edition, 1996.

Course outcomes-

Students will be able to:

1. Acquire the knowledge on the principles of wind energy generation and solar energy generation.
2. Realize wind energy and solar energy impact on power and voltage quality.
3. Solve the problems related to issues associated with wind and solar energy.

PROGRAM ELECTIVE- III

PSPE 03.1: POWER QUALITY ISSUES AND MITIGATION

Instruction Hours/week: 3(L) & 1(T) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT –I

Electric power quality phenomena- Introduction to Power Quality, IEC and IEEE definitions - power quality disturbances-voltage fluctuations – sags - swells – transients – unbalance - waveform distortion - power frequency variations.

UNIT–II

Transients – origin of transients - classifications of transients – capacitor switching transient – lightning transients - load switching transients – impact on users – protection against transients – mitigation of transients.

UNIT–III

Voltage Variations – Voltage Sags – Magnitude & Duration – types – Sources of Sags – Estimation of Voltage sag performance: Transmission and Utility distribution system, Effect of Sag on AC Motor Drives, Single – Phase Domestic and Office loads, mitigation of Voltage Sag. Origin of Long and Short interruption – influence on various equipments –Mitigation of interruption.

UNIT –IV

Harmonics – Introduction to harmonics - sources of harmonics – definitions & standards – impacts - calculation and simulation –harmonic power flow - mitigation and control techniques – filtering – passive and active.

UNIT–V

Power Quality Mitigation Techniques: Harmonics filters: passive, Active and hybrid filters – Customer power device: Load compensation using DSTATCOM, Voltage regulation using DSTATCOM, protecting sensitive loads using DVR, UPQC: Status of application of customer power devices.

Text Books:

1. G.T. Heydt, " Electric Power Quality", Stars in a Circle Publishers.
2. M.H. Bollen, " Understanding Power Quality Problems", Wiley – IEEE Press.
3. J. Arrillaga, B.C. Smith, N.R. Waston & AR Wood, " Power System Harmonic Analysis", John Wiley.
4. Bollen, M.H.J., 'Understanding Power Quality Problems: Voltage sags and interruptions', IEEE Press, New York, 1999.
5. Arrillaga, J, Watson, N.R., Chen, S., 'Power System Quality Assessment', Wiley, New York, 1999.
6. Heydt, G.T., 'Electric Power Quality', Stars in a Circle Publications, Indiana, 1991.
7. RC Dugan, 'Electrical Power Systems Quality', Mc-Graw Hill.

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the basic concepts of power quality.
2. Understand the basic concepts of voltage variations and transients
3. Understand different harmonics in power systems
4. Understand the working of Power quality conditioners.

PSPE 03.2: RESTRUCTURED POWER SYSTEMS

Instruction Hours/week: 3(L) & 1(T) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Introduction to restructuring of power industry: Deregulation of power industry, unbundling of electric utilities, Issues involved in deregulation, Deregulation of various power systems – Fundamentals of Economics: Consumer behavior, Supplier behavior, Market equilibrium, short and long run costs, Various costs of production – Market models: Market models based on Contractual arrangements, Comparison of various market models, Market Mechanism.

UNIT-II

Power System Operation in Competitive Environment: Role of the independent system operator, Operational planning activities of ISO: ISO in Pool markets, ISO in Bilateral markets, Operational planning activities of a GENCO: GENCOs in Pool and Bilateral markets, market participation issues, competitive bidding.

UNIT-III

Transmission congestion management: Definition of Congestion, reasons for transfer capability limitation, Importance of congestion management, Features of congestion management –Classification of congestion management methods –Calculation of ATC -Non – market methods –Market methods –Nodal pricing –Inter zonal and Intra zonal congestion management –Price area congestion management –Capacity alleviation method.

UNIT-IV

Ancillary service management and pricing of transmission network: Introduction of ancillary services –Types of Ancillary services –Classification of Ancillary services –Load generation balancing related services –Voltage control and reactive power support devices –Black start capability service -ancillary service –Co-optimization of energy and reserve services -International comparison Transmission pricing –Principles –Classification –Role in transmission pricing methods –Marginal transmission pricing paradigm –Composite pricing paradigm –Merits and demerits of different paradigm.

UNIT-V

Power market development in India: Institutional structure in Indian Power sector, generation, transmission and distribution utilities. SO, & LDCs. PFC, REC, ERCs, traders, Power Exchanges and their roles. Availability based tariff, Open access, Industry structure and regulatory framework, market development, RE policies, RPO, Tariff policies. Policy changes, regulatory changes, Critical issues / challenges before the Indian power sector.

Text Books:

1. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley and Sons, 1st edition, 2002.
2. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems", Springer, 1st edition, 2001.
3. Mohammad Shahidehpour, Muwaffaq Alomoush, "Restructured electrical power systems: operation, trading and volatility", CRC Press; 1st edition, 2017.
4. Loi Lei Lai: Power System Restructuring and Deregulation: Trading, Performance and Information Technology, John Wiley & Sons, Pvt. Ltd., 1st edition, 2001.

Course outcomes-

Students will be able to:

1. Understand the basic reasons and motivations for restructuring worldwide.
2. Understand the roles and responsibilities of different entities in electricity market.
3. Explore issues like congestion management, Transmission pricing, Ancillary Services.
4. Understand the power market scenarios in India.

PSPE 03.3: POWER APPARATUS AND DESIGN

Instruction Hours/week: 3(L) & 1(T) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Principles of Design of Machines -Specific loadings, choice of magnetic and electric loadings, Real and apparent flux densities, temperature rise calculation, Separation of main dimension for DC machines, Induction machines and synchronous machines
Design of Transformers-General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling tubes

UNIT-II

Separation of main dimension for DC machines, Induction machines and synchronous machines, Heating and cooling of machines, types of ventilation, continuous and intermittent rating

UNIT-III

General considerations, output equation for induction machines, Choice of specific electric and magnetic loadings, efficiency, power factor, Number of slots in stator and rotor, Elimination of harmonic torques

UNIT-IV

Design of stator and rotor winding, slot leakage flux, Leakage reactance, equivalent resistance of Magnetizing current, efficiency from design data

UNIT-V

Types of alternators, comparison, specific loadings, output co-efficient, design of main dimensions, Introduction to Computer Aided Electrical Machine Design Energy efficient machines.

Text Books:

1. Clayton A.E, "The Performance and Design of D.C. Machines", Sir I. Pitman & sons, Ltd.
2. M.G. Say, "The Performance and Design of A.C. Machines ", Pitman
3. Sawhney A.K, "A course in Electrical Machine Design", DhanpatRai & Sons, 5th Edition

Course outcomes-

Students will be able to:

1. To give a systematic approach for design and analysis of all rotating machines under both transient and steady state conditions with the dimensions and material used.
2. Ability to design all types of transformers and special machines.

PSPE 03.4: ADVANCED DIGITAL SIGNAL PROCESSING

Instruction Hours/week: 3(L) & 1(T) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Discrete time signals, Linear shift invariant systems-Stability and causality. Sampling of continuous time signals-Discrete time Fourier transform- Discrete Fourier series- Discrete Fourier transform, Z Transform-Properties of different transforms

UNIT-II

Linear convolution using DFT, Computation of DFT Design of IIR digital filters from analog filters, Impulse invariance method, Bilinear transformation method

UNIT-III

FIR filter design using window functions, Comparison of IIR and FIR digital filters, Basic IIR and FIR filter realization structures, Signal flow graph representations Quantization process and errors, Coefficient quantization effects in IIR and FIR filters

UNIT-IV

A/D conversion noise- Arithmetic round-off errors, Dynamic range scaling, Overflow oscillations and zero Input limit cycles in IIR filters, Linear Signal Models

UNIT-V

All pole, All zero and Pole-zero models, Power spectrum estimation- Spectral analysis of deterministic signals, Estimation of power spectrum of stationary random signals

Text Books:

1. Sanjit K Mitra, "Digital Signal Processing: A computer-based approach ", Tata Mc Grow-Hill Edition1998
2. Dimitris G. Manolakis, Vinay K. Ingle and Stephen M. Kogon, "Statistical and Adaptive Signal Processing", Mc Grow Hill international editions. -2000

Course outcomes-

Students will be able to:

1. Knowledge about the time domain and frequency domain representations as well analysis of discrete time signals and systems
2. Study the design techniques for IIR and FIR filters and their realization structures.
3. Acquire knowledge about the finite word length effects in implementation of digital filters.
4. Knowledge about the various linear signal models and estimation of power spectrum of stationary random signals
5. Design of optimum FIR and IIR filters

PSPE 04.1: ELECTRIC AND HYBRID VEHICLES

Instruction Hours/week: 3(L) & 1(T) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies, Basics of vehicle performance, vehicle power source characterization, Transmission characteristics, Mathematical models to describe vehicle performance

UNIT-II

Vehicle mechanics, roadway fundamentals, laws of motion, vehicle kinetics, dynamics of vehicle motion, propulsion power, velocity and acceleration, propulsion system design Basic concept of hybrid Electric drive Tains, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies.

UNIT-III

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Introduction Motor drives configuration and control of Permanent Magnet Motor Drives Configuration and control of Switch Reluctance, Motor drives, drive system efficiency

UNIT-IV

Matching the electric machine and the internal combustion engine (ICE) Sizing the propulsion motor, sizing the power electronics Selecting the energy storage technology, Communications, supporting subsystems

UNIT-V

Introduction to energy management and their strategies used in hybrid and electric vehicle, Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies

Text Books:

1. Iqbal Husain, “Electric and Hybrid Vehicles Design Fundamentals”, CRC Press.
2. Mehrdad Ehsani, Yimin Gao, Sebastien, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRC Press

Course outcomes-

Students will be able to:

1. Acquire knowledge about fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
2. To learn electric drive-in vehicles and traction

PSPE 04.2: INDUSTRIAL POWER ELECTRONICS

Instruction Hours/week: 3(L) & 1(T) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT – I

Basic power electronic drive system, components. Different types of loads, shaft-load coupling systems. Stability of power electronic drive,
Introduction to overvoltage conditions and protection, practical overvoltage protection in naturally and forced commutated circuits, overcurrent fault conditions, over current protection, gate protection, heat sinks.

UNIT – II

Modeling of DC machine, Conventional methods of D.C. motor speed control, single phase and three phase converter fed D.C motor drive. Power factor improvement techniques, four quadrant operation. steady-state analysis of the three-phase converter-controlled DC motor drive.

UNIT – III

Chopper fed drives, input filter design. Braking and speed reversal of DC motor drives using choppers, multiphase choppers, steady-state analysis of chopper-controlled DC motor drive, closed-loop operation, dynamic simulation of the speed-controlled DC motor drive.

UNIT – IV

Conventional methods of induction motor speed control. Solid state controllers for Stator voltage control, soft starting of induction motors, Rotor side speed control of wound rotor induction motors. Voltage source and Current source inverter fed induction motor drives – d-q axis modeling and vector control.

UNIT – V

Speed control of synchronous motors, field-oriented control, load commutated inverter drives, switched reluctance motors and permanent magnet motor drives. Introduction to design aspects of machines.

Text Books:

1. P.C Sen, 'Thyristor DC Drives', John Wiley and Sons, New York, 1991.
2. R. Krishnan, 'Electric Motor Drives – Modeling, Analysis and Control', Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.
3. Bimal K. Bose, 'Modern Power Electronics and AC Drives', Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.
4. M D Singh, K B Khanchandani, "Power Electronics", Tata Mcgraw-Hill Publishing company limited, New Delhi,2008.

Course Outcomes:

Upon completion of the course, the students will be able to

1. Understand and analyze dc and ac motors supplied from different power converters.
2. Simulate and study motor characteristics with different converter configurations
3. Design and implement a prototype drive system.

PSPE 04.3: SCADA SYSTEM AND APPLICATIONS

Instruction Hours/week: 3(L) & 1(T) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

SCADA: Introduction to SCADA, Line diagram of SCADA system, Data acquisition systems, Evolution of SCADA, Monitoring and supervisory functions, Communication technologies,

UNIT-II

SCADA COMPONENTS: Industries SCADA System Components, Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems

UNIT-III

SCADA ARCHITECTURE: SCADA architectures, Various types of technique and applications, advantages and disadvantages of each system, single unified standard architecture -IEC 61850

UNIT-IV

SCADA COMMUNICATION: Schematic diagram of SCADA Communication system, various industrial communication technologies, wired and wireless methods and fiber optics, Open standard communication protocols

UNIT-V

SCADA APPLICATIONS: Utility applications, Transmission and Distribution sector operations, monitoring, analysis and improvement, Industries - oil, gas and water, Case studies, Implementation, Simulation Exercises

Text Books:

1. Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA, 2004.
2. Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK, 2004.
3. William T. Shaw, "Cybersecurity for SCADA systems", PennWell Books, 2006.
4. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 2003.
5. Michael Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power", PennWell 1999.

Course outcomes-

Students will be able to:

1. Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications
2. Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system
3. Knowledge about single unified standard architecture IEC 61850
4. To learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server

PSPE 04.4: EMBEDDED SYSTEMS

Instruction Hours/week: 3(L) & 1(T) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Introduction: Processor embedded into system, Embedded Hardware Units, Embedded Software in a system, Embedded system-on-Chip (SOC), Design process, Classification of embedded systems

UNIT-II

8051 and Advanced Processor architecture, Memory Organization and Real- World Interfacing: 8051 architecture, Real world interfacing, Introduction to advanced architecture, Processor and memory organization, Instruction-level-parallelism, Performance matrices, Processor selection, Memory selection

UNIT-III

Devices and Communication buses for Devices and network: I/O types and examples, serial communication devices, Parallel device ports, Wireless devices, Timer and Counting devices, Watch dog timer, real time clock

UNIT-IV

Device Drivers and Interrupts service Mechanism. Programmed I/O Busy- Approach with interrupt service mechanism, ISR concept, Interrupt sources, Interrupt handling mechanism, multiple interrupts, DMA, Device driver programming

UNIT-V

Real-Time- Operating systems: OS Services, Process management, Timer functions, Event functions, Memory management, Real- time Operating systems, Basic design using an RTOS. Introduction to Real time Operating Systems: Windows CE, OSEK, Linux 2.6.X and RT Linux

Text Books:

1. Raj Kamal, “Embedded Systems” (T M H), 2008.
2. Peter Marwedel, “Embedded System Design” – Springer Verlog, 2006.
3. Jane W. S. Liu, “Real time Systems”, -Pearson Education, 2000

Course outcomes-

Students will be able to:

1. Program embedded system with 8051 as processor.
2. Understand different types of communication through, parallel ports, wireless
3. Understand significance of device drivers and interrupt mechanism
4. Understand features of different types of real time OS.

PSCP 03: POWER SYSTEM PROTECTION LAB

Instruction Hours/week: 3(P) **Credits: 1.5**
Sessional Marks: 40 **Semester-End Examination: 60**

S.No	EXPERIMENTS
1	Fault Analysis by using the Symmetrical and Unsymmetrical fault MATLAB Simulink model.
2	Transmission fault detection by using Wavelet applications MATLAB Simulink model.
3	Working with Transformer Differential relay model JND, 040
4	Pickup test for Differential Relay.
5	Transformer protection using the Differential Relay for Zone trip fault.
6	Transformer Out Zone (or) Non- Trip faults.
7	Operation of Electromechanical type Earth Fault Relay.
8	Operation of Electromechanical type Over Voltage Relay.
9	Percentage Differential Relay.
10	Micro Controller Based Over Current Relay.
11	Micro Controller Based Over / Under Voltage Relay.

Note: Any **Ten** Experiments are to be conducted.

PSCP 04: WIND AND SOLAR ENERGY SYSTEMS LAB.

Instruction Hours/week: 3(P) **Credits: 1.5**
Sessional Marks: 40 **Semester-End Examination: 60**

S. No	EXPERIMENTS
1	IV & PV characteristics of series and parallel combination of PV module.
2	IV & PV characteristics of PV module with varying the radiation and temperature level.
3	Effect of shading on output power of module.
4	Effect of variation in tilt angle on PV module power.
5	Simulation of IV – PV Curves.
6	Modeling & Simulation of wind turbine generator in MATLAB Simulink.
7	Power Equation simulation for wind turbine.
8	Evaluation of Tip Speed ratio at different wind speed.
9	Evaluation of the efficiency of charge controller.
10	Evaluation of co-efficient of performance of wind turbine.

Note: All the **Ten** Experiments are to be conducted.

PSVAC01: ELECTRICAL SAFETY AND MANAGEMENT

Instruction Hours/week: 3(L) & 1(T) **Credits: 3**

Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

INTRODUCTION TO ELECTRICAL SAFETY, SHOCKS AND THEIR PREVENTION: Terms and definitions, objectives of safety and security measures, Hazards associated with electric current, and voltage, principles of electrical safety, Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, approaches to prevent Accidents.

UNIT-II

ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS: Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances

UNIT-III

ELECTRICAL SAFETY IN HAZARDOUS AREAS: Hazardous zones – class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements –Specifications of electrical plants, equipments for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapours – classification of equipment/enclosure for hazardous locations.

UNIT- IV

ELECTRICAL SAFETY DEVICES: Fire Extinguishers: Fundamentals of fire-initiation of fires, types; extinguishing techniques, prevention of fire, types of fire extinguishers, fire detection and alarm system; CO2 and Halogen gas schemes; foam schemes.

UNIT-V

SAFETY DURING INSTALLATION OF PLANT: Introduction, preliminary preparations, preconditions for start of installation work, during, risks during installation of electrical plant and equipment, safety aspects during installation, field quality and safety during erection, personal protective equipment for erection personnel.

SAFETY MANAGEMENT OF ELECTRICAL SYSTEMS: Principles of Safety Management, Management Safety Policy, Safety organization, safety auditing, Motivation to managers, supervisors, employees.

Text Books:

1. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1988.
2. Pradeep Chaturvedi, "Energy Management Policy, Planning and Utilization", Concept Publishing Company, 1997.

Reference Books:

1. Cooper.W.F, "Electrical safety Engineering", Newnes-Butterworth Company, 1978.
2. John Codick, "Electrical safety hand book", McGraw Hill Inc., New Delhi, 2000.
3. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1998.
4. Wadhwa, C.L., "Electric Power Systems", New Age International, 2004.

Course outcomes:

At the end of the course, students will be able to

1. Understand the necessity of electrical safety
2. Know about Hazardous zones
3. Apply different safety measures to various machines and equipment
4. Understand the electrical management principles

PSMPS00: MINI-PROJECT WITH SEMINAR

Instruction Hours/week: 1(L) & 2(P) **Credits: 2**
Sessional Marks: 40 **Semester-End Examination: 60**

Mini-Project with Seminar course is a project-based learning methodology in Power System Analysis

Course outcomes: Students will be able to**:**

1. Know the meaning of research problem, Sources of research problem Approaches of investigation of solutions for research problem.
2. Understand effective literature studies approaches, analysis Effective technical writing.
3. Learn how to write an assessment report and preparation of documentation and presentation.
4. Know the criteria characteristics of good research problem.
5. Acquire the knowledge of comprehensive analysis in Electrical Power Network.



M.TECH – III SEMESTER

COURSE INSTRUCTIONS

(R23 REGULATIONS)

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING
M.TECH: POWER SYSTEMS - THIRD SEMESTER - SYLLABUS

PGOE01: OPEN ELECTIVE COURSE (MOOCS)

Instruction Hours/week: 3(L)-MOOCS (12 weeks) **Credits: 3**

Sessional Marks: 00 **Semester-End Examination: 100**

Instructions of the course: The Students can undergo Open Elective Course work (12 week's duration) from the day of commencement of Second semester class work through online (MOOCS)/ NPTEL and can select the subjects that are not covered in the Curriculum. However, the obtained pass certificate should be submitted on or before the last working day of the III - Semester Course work without fail and result will be reflected in III - Semester Marks MEMO. Otherwise, the results will be reflected in supplementary mode.

PSPD01: DISSERTATION PROJECT WORK PHASE-I

Instruction Hours/week: 24(P) **Credits: 12**

Sessional Marks: 20+40 **Semester-End Examination: 40**

Instructions of the course: The Students will acquire knowledge about research problem, sources of research problem Approaches of investigation of solutions for research problem and understand effective literature studies approaches and analysis.

Scheme of Evaluation of Dissertation project work Phase – I: Review after 6 – 8 weeks (20 marks), Continuous Guide Evaluation (40 marks) and End Semester Evaluation (40 marks). – Total Marls: 100 marks.



M.TECH – IV SEMESTER

COURSE INSTRUCTIONS

(R23 REGULATIONS)

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING
M.TECH: POWER SYSTEMS - FOURTH SEMESTER - SYLLABUS

PSPD02: DISSERTATION PROJECT WORK PHASE – II AND VIVA-VOCE

Instruction Hours/week: 32(P) **Credits: 16**

Sessional Marks: 20+40 **Semester-End Examination: 40**

Instructions of the course: The Student will be able to analyze and solve the problem with programmable code/Simulink to obtain appropriate solution, how to write a assessment report and preparation of project work/documentation and presentation of results.
The student must publish the work in a reputed reviewed UGC approved journal.

Scheme of Evaluation of Dissertation project work Phase – II:

1. Review after 8-10 weeks (20 marks) and Continuous Guide Evaluation (40 marks) and End Semester Examination (40 marks).
2. Student must submit their project work on or before the last working day/Instruction Day of the IV Semester of the Program. Otherwise Rs. 1,000/- penalty for late submission will be levied to extend submission up to three months. In case of failure of the said condition the penalty amount will be doubled up to the completion of the course work.



SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18)

Table 1.1.1. Details of courses addressing Local, National, Regional and Global Developmental Needs.

I. Local Needs

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech H&WRE	1-1422777040	Advanced Fluid Mechanics	HWPC01	2018
		Free Surface Flows	HWPC02	2018
		Professional Elective- I		
		Fluvial Hydraulics	HWPE11	2018
		Hydraulic Structures	HWPE12	2018
		Systems Engineering	HWPE13	2018
		Hydraulic Modeling and Experimental techniques	HWPE14	2018
		Professional Elective- II		
		Water Resources System Planning	HWPE21	2018
		Irrigation and Drainage	HWPE22	2018
		Water Power Engineering	HWPE23	2018
		Urban Hydrology	HWPE24	
		Advanced Fluid Mechanics Lab	HWCP01	2018
		Advanced Hydrology Lab	HWCP02	2018
		Audit Course-I		
		English for Research Paper Writing	PGPA11	2018
		Disaster Management	PGPA12	2018
		Sanskrit for Technical Knowledge	PGPA13	2018
		Value Education	PGPA14	2018
		Research Methodology and IPR	PGPC41	2018

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18)

M.Tech H&WRE	1-1422777040	Advanced Hydrology	HWPC03	2018
		Groundwater Engineering	HWPC04	2018
		Professional Elective- III		2018
		Computational Methods in Fluid Mechanics	HWPE31	2018
		Theory and Applications of GIS	HWPE32	2018
		Hydrogeology and Geophysical exploration of groundwater	HWPE33	2018
		Coastal Engineering	HWPE34	2018
		Professional Elective- IV		
		Environmental Hydraulics	HWPE41	2018
		Advanced Numerical Analysis	HWPE42	2018
		River Water Management	HWPE43	2018
		Theory of Seepage and groundwater movement	HWPE44	2018
		Computational Fluid Dynamics Lab	HWCP03	2018
		Open Chanel Flow Lab	HWCP04	2018
		Audit Course-II		
		Constitution Of India	PGPA21	2018
		Pedagogy Studies	PGPA22	2018
		Stress Management By Yoga	PGPA23	2018
		Personality Development Through Life Enlightenment Skills	PGPA24	2018
		Mini Project	HWMP01	2018
M.Tech H&WRE	1-1422777040	**Professional Elective- V**		
		Computer Methods in Hydraulics and Hydrology	HWPE51	2019
		Stochastic Hydrology	HWPE52	2019
		Watershed Management and Modeling	HWPE53	2019
		Climate Change and Sustainable Development	HWPE54	2019
		Open Elective- I		

		Business Analytics	HWOE11	2019
		Industrial Safety	HWOE12	2019
		Operations Research	HWOE13	2019
		Cost Management of Engineering Projects	HWOE14	2019
		Composite Materials	HWOE15	2019
		Energy Generation from Waste	HWOE16	2019
		Major project: Phase-I Dissertation	HWPD01	2019
M.Tech H7WRE	1-1422777040	Major project: Phase-II Dissertation	HWPD02	2019

II. National Initiatives/Needs

National Green Energy Initiatives:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech H&WRE	1-1422777040	Composite Materials	HWOE15	2019
		Energy Generation from Waste	HWOE16	2019

National Biotechnology Initiatives:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech H&WRE	1-1422777040	----	---	--

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18)

Geographical Integration System (GIS) Initiatives:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech H&WRE	1-1422777040	Advanced Hydrology Lab	HWCP02	2018
		Theory and Applications of GIS	HWPE32	2018

National Digital Initiatives:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech H&WRE	1-1422777040	Computational Fluid Dynamics Lab	HWCP03	2018

Initiatives on Environment & Sustainability:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech H&WRE	1-1422777040	Energy Generation from Waste	HWOE16	2019

Initiatives on Water Resources & Sustainability:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech H&WRE	1-1422777040	Climate Change and Sustainable Development	HWPE54	2019

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18)

Initiatives on Agricultural & Sustainability:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech H&WRE	1-1422777040	----	---	--

Initiatives on Health & Sustainability:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech H&WRE	1-1422777040	----	---	--

Initiatives on Nanovission & Sustainability:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech H&WRE	1-1422777040	----	---	--

Initiatives on Translational Mission:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech H&WRE	1-1422777040	Sanskrit for Technical Knowledge	PGPA13	2018

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18)

Initiatives on Sarva Siksha Abhiyan:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech H&WRE	1-1422777040	Stress Management By Yoga	PGPA23	2018
		Personality Development Through Life Enlightenment Skills	PGPA24	2018

Initiatives on Rural Development:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech H&WRE	1-1422777040	Cost Management of Engineering Projects	HWOE14	2019

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18)

III. Regional Needs:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech H&WRE	1-1422777040	Advanced Fluid Mechanics	HWPC01	2018
		Free Surface Flows	HWPC02	2018
		Professional Elective- I		
		Fluvial Hydraulics	HWPE11	2018
		Hydraulic Structures	HWPE12	2018
		Systems Engineering	HWPE13	2018
		Hydraulic Modeling and Experimental techniques	HWPE14	2018
		Professional Elective- II		
		Water Resources System Planning	HWPE21	2018
		Irrigation and Drainage	HWPE22	2018
		Water Power Engineering	HWPE23	2018
		Urban Hydrology	HWPE24	
		Advanced Fluid Mechanics Lab	HWCP01	2018
		Advanced Hydrology Lab	HWCP02	2018
		Audit Course-I		
		English for Research Paper Writing	PGPA11	2018
		Disaster Management	PGPA12	2018
		Sanskrit for Technical Knowledge	PGPA13	2018
		Value Education	PGPA14	2018
		Research Methodology and IPR	PGPC41	2018
M.Tech H&WRE	1-1422777040	Advanced Hydrology	HWPC03	2018

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18)

		Groundwater Engineering	HWPC04	2018
		Professional Elective- III		2018
		Computational Methods in Fluid Mechanics	HWPE31	2018
		Theory and Applications of GIS	HWPE32	2018
		Hydrogeology and Geophysical exploration of groundwater	HWPE33	2018
		Coastal Engineering	HWPE34	2018
		Professional Elective- IV		
		Environmental Hydraulics	HWPE41	2018
		Advanced Numerical Analysis	HWPE42	2018
		River Water Management	HWPE43	2018
		Theory of Seepage and groundwater movement	HWPE44	2018
		Computational Fluid Dynamics Lab	HWCP03	2018
		Open Chanel Flow Lab	HWCP04	2018
		Audit Course-II		
		Constitution Of India	PGPA21	2018
		Pedagogy Studies	PGPA22	2018
		Stress Management By Yoga	PGPA23	2018
		Personality Development Through Life Enlightenment Skills	PGPA24	2018
		Mini Project	HWMP01	2018
M.Tech H&WRE	1-1422777040	**Professional Elective- V**		
		Computer Methods in Hydraulics and Hydrology	HWPE51	2019
		Stochastic Hydrology	HWPE52	2019
		Watershed Management and Modeling	HWPE53	2019
		Climate Change and Sustainable Development	HWPE54	2019
		Open Elective- I		
		Business Analytics	HWOE11	2019
		Industrial Safety	HWOE12	2019

		Operations Research	HWOE13	2019
		Cost Management of Engineering Projects	HWOE14	2019
		Composite Materials	HWOE15	2019
		Energy Generation from Waste	HWOE16	2019
		Major project: Phase-I Dissertation	HWPD01	2019
M.Tech H7WRE	1-1422777040	Major project: Phase-II Dissertation	HWPD02	2019

III. Global Needs:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech H&WRE	1-1422777040	Disaster Management	PGPA12	2018
		Research Methodology and IPR	PGPC41	2018
		Business Analytics	SEOE11	2019
		Industrial Safety	SEOE12	2019
		Operations Research	SEOE13	2019

1.1.3. Employability/ Entrepreneurship/ Skill development – Mapping

S. No.	Name of the Programme	Course Code	Title of the Course	Year of Introduction	Employ ability	Entrepre neurship	Skill development
1	M.Tech H&WRE	HWPC01	Advanced Fluid Mechanics	2018	√	√	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18)

2		HWPC02	Free Surface Flows	2018	√		
			Professional Elective- I				
3		HWPE11	Fluvial Hydraulics	2018	√		
4		HWPE12	Hydraulic Structures	2018	√		
5		HWPE13	Systems Engineering	2018	√		
6		HWPE14	Hydraulic Modeling and Experimental techniques				
			Professional Elective- II				
7		HWPE21	Water Resources System Planning	2018	√		
8		HWPE22	Irrigation and Drainage	2018	√		
9		HWPE23	Water Power Engineering	2018	√		
		HWPE24	Urban Hydrology		√		
10		HWCP01	Advanced Fluid Mechanics Lab	2018	√	√	√

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18)

11		HWCP02	Advanced Hydrology Lab	2018	√	√	√
			Audit Course-I				
12		PGPA11	English for Research Paper Writing	2018			√
13		PGPA12	Disaster Management	2018	√	√	√
14		PGPA13	Sanskrit for Technical Knowledge	2018			√
15		PGPA14	Value Education	2018	√		
16		PGPC41	Research Methodology and IPR	2018	√	√	
17		HWPC03	Advanced Hydrology	2018	√		
18		HWPC04	Groundwater Engineering	2018	√	√	√
			Professional Elective- III				
19		HWPE31	Computational Methods in Fluid Mechanics	2018	√	√	
20		HWPE32	Theory and Applications of GIS	2018	√	√	√

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18)

21		HWPE33	Hydrogeology and Geophysical exploration of groundwater	2018	√	√	
22		HWPE34	Coastal Engineering	2018	√	√	
			Professional Elective- IV				
23		HWPE41	Environmental Hydraulics	2018	√	√	
24		HWPE42	Advanced Numerical Analysis	2018	√	√	
25		HWPE43	River Water Management	2018	√		
26		HWPE44	Theory of Seepage and groundwater movement	2018	√	√	
27		HWCP03	Computational Fluid Dynamics Lab	2018	√	√	√
28		HWCP04	Open Chanel Flow Lab	2018	√	√	√
			Audit Course-II				
29		PGPA21	Constitution Of India	2018	√	√	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18)

30		PGPA22	Pedagogy Studies	2018			√
31		PGPA23	Stress Management By Yoga	2018			√
32		PGPA24	Personality Development Through Life Enlightenment Skills	2018			√
33		HWMP01	Mini Project	2018	√	√	√
			Professional Elective- V				
34		HWPE51	Computer Methods in Hydraulics and Hydrology	2019	√	√	
35		HWPE52	Stochastic Hydrology	2019	√	√	
36		HWPE53	Watershed Management and Modeling	2019	√	√	
37		HWPE54	Climate Change and Sustainable Development	2019	√	√	
			Open Elective- I				
38		HWOE11	Business Analytics	2019		√	

39		HWOE12	Industrial Safety	2019	√		
40		HWOE13	Operations Research	2019	√		
41		HWOE14	Cost Management of Engineering Projects	2019	√		
42		HWOE15	Composite Materials	2019	√		
43		HWOE16	Energy Generation from Waste	2019	√		
44		HWPD01	Major project: Phase-I Dissertation	2019	√	√	√
45		HWPD02	Major project: Phase-II Dissertation	2019	√	√	√

1.1.3. Average percentage of Courses having focus on Employability/ Entrepreneurship/ Skill development during the last five years.

S. No	Course Code	Title of the Course	Year of Introduction	Average percentage of Courses having focus on Employability during the last five years
1.	HWPC01	Advanced Fluid Mechanics	2018	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18)

2.	HWPC02	Free Surface Flows	2018	**35/45= 77.77%**
3.	HWPE11	Fluvial Hydraulics	2018	
4.	HWPE12	Hydraulic Structures	2018	
5.	HWPE14	Hydraulic Modeling and Experimental techniques	2018	
6.	HWPE21	Water Resources System Planning	2018	
7.	HWPE22	Irrigation and Drainage	2018	
8.	HWPE23	Water Power Engineering	2018	
9.	HWPE24	Urban Hydrology	2018	
10.	PGPA12	Disaster Management	2018	
11.	PGPA14	Value Education	2018	
12.	PGPC41	Research Methodology and IPR	2018	
13.	HWPC03	Advanced Hydrology	2018	
14.	HWPC04	Groundwater Engineering	2018	
15.	HWPE31	Computational Methods in Fluid Mechanics	2018	
16.	HWPE32	Theory and Applications of GIS	2018	
17.	HWPE33	Hydrogeology and Geophysical exploration of groundwater	2018	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18)

18.	HWPE34	Coastal Engineering	2018	
19.	HWPE41	Environmental Hydraulics	2018	
20.	HWPE42	Advanced Numerical Analysis	2018	
21.	HWPE43	River Water Management	2018	
22.	HWPE44	Theory of Seepage and groundwater movement	2018	
23.	PGPA21	Constitution Of India	2018	
24.	HWMP01	Mini Project	2018	
25.	HWPE51	Computer Methods in Hydraulics and Hydrology	2019	
26.	HWPE52	Stochastic Hydrology	2019	
27.	HWPE53	Watershed Management and Modeling	2019	
28.	HWPE54	Climate Change and Sustainable Development	2019	
29.	HWOE12	Industrial Safety	2019	
30.	HWOE13	Operations Research	2019	
31.	HWOE14	Cost Management of Engineering Projects	2019	
32.	HWOE15	Composite Materials	2019	
33.	HWOE16	Energy Generation from Waste	2019	
34.	HWPD01	Major project: Phase-I Dissertation	2019	
35.	HWPD02	Major project: Phase-II Dissertation	2019	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18)

S. No	Course Code	Title of the Course	Year of Introduction	Average percentage of Courses having focus on Entrepreneurship during the last five years
1.	HWPC01	Advanced Fluid Mechanics	2018	20/45=44.44%
2.	HWCP01	Advanced Fluid Mechanics Lab	2018	
3.	HWCP02	Advanced Hydrology Lab	2018	
4.	PGPA12	Disaster Management	2018	
5.	PGPC41	Research Methodology and IPR	2018	
6.	HWPE31	Computational Methods in Fluid Mechanics	2018	
7.	HWPE32	Theory and Applications of GIS	2018	
8.	HWPE33	Hydrogeology and Geophysical exploration of groundwater	2018	
9.	HWPE41	Environmental Hydraulics	2018	
10.	HWPE42	Advanced Numerical Analysis	2018	
11.	HWPE43	River Water Management	2018	
12.	HWPE44	Theory of Seepage and groundwater movement	2018	
13.	PGPA21	Constitution Of India	2018	
14.	HWMP01	Mini Project	2018	
15.	HWPE51	Computer Methods in Hydraulics and Hydrology	2019	
16.	HWPE52	Stochastic Hydrology	2019	
17.	HWPE53	Watershed Management and Modeling	2019	
18.	HWOE11	Business Analytics (OE)	2019	
19.	HWPD01	Major project: Phase-I Dissertation	2019	
20.	HWPD02	Major project: Phase-II Dissertation	2019	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18)

S. No	Course Code	Title of the Course	Year of Introduction	Average percentage of Courses having focus on Skill development during the last five years
1	HWCP01	Advanced Fluid Mechanics Lab	2018	**8/45=17.77%**
2	HWCP02	Advanced Hydrology Lab	2018	
3	PGPA12	Disaster Management	2018	
4	HWCP03	Computational Fluid Dynamics Lab	2018	
5	HWCP04	Open Chanel Flow Lab	2018	
6	HWMP01	Mini Project	2018	
7	HWPD01	Major project: Phase-I Dissertation	2019	
8	HWPD02	Major project: Phase-II Dissertation	2019	

1.2.1. Percentage of new Courses introduced of the total number of courses across all programmes offered during the last five years.

S. No	Course Code	Title of the Course	Year of Introduction	If revision has been carried out in the syllabus during last 5 years, Percentage of content added or replaced
1.	HWPC01	Advanced Fluid Mechanics	2018	**26/45=57.77%**
2.	HWPC02	Free Surface Flows	2018	
3.	HWCP01	Advanced Fluid Mechanics Lab	2018	
4.	HWCP02	Advanced Hydrology Lab	2018	
5.	PGPA11	English for Research Paper Writing	2018	
6.	PGPA13	Sanskrit for Technical Knowledge	2018	
7.	PGPA14	Value Education	2018	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18)

8.	PGPC41	Research Methodology and IPR	2018	
9.	HWPC03	Advanced Hydrology	2018	
10.	HWPC04	Groundwater Engineering	2018	
11.	HWPE31	Computational Methods in Fluid Mechanics	2018	
12.	HWPE32	Theory and Applications of GIS	2018	
13.	HWCP03	Computational Fluid Dynamics Lab	2018	
14.	PGPA21	Constitution Of India	2018	
15.	PGPA22	Pedagogy Studies	2018	
16.	PGPA23	Stress Management By Yoga	2018	
17.	PGPA24	Personality Development Through Life Enlightenment Skills	2018	
18.	HWPE54	Climate Change and Sustainable Development	2019	
19.	HWOE11	Business Analytics	2019	
20.	HWOE12	Industrial Safety	2019	
21.	HWOE13	Operations Research	2019	
22.	HWOE14	Cost Management of Engineering Projects	2019	
23.	HWOE15	Composite Materials	2019	
24.	HWOE16	Energy Generation from Waste	2019	
25.	HWPD01	Major project: Phase-I Dissertation	2019	
26.	HWPD02	Major project: Phase-II Dissertation	2019	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18)

S. No	Name of the Course	Course Code	Year of introduction	Activities/Content with direct bearing on Employability/Entrepreneurship/ Skill development	Link to relevant Document
	I Semester				
	Professional Elective- I				
1	Hydraulic Modeling and Experimental techniques	HWPE14	2018	Analyse and design of Hydraulic modelling in case of dams and bridges	
	Professional Elective- II				
2	Urban Hydrology	HWPE24	2018	Design of storm water management	
4	Advanced Fluid Mechanics Lab	HWCP01	2018	Experimentation of flow through open chanals.	
5	Advanced Hydrology Lab	HWCP02	2018	Design and analysis of watershed characteristics by using remote sensing and GIS	
6	English for Research Paper Writing	PGPA11	2018	understand how to improve writing skills and level of readability	
7	Sanskrit for Technical Knowledge	PGPA13	2018	understand the Ancient Sanskrit literature about science & technology	
8	Value Education	PGPA14	2018	acquire the knowledge of self-	

				development	
9	Research Methodology and IPR	PGPC41	2018	Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.	
	II Semester				
	Professional Elective- III				
10	Theory and Applications of GIS	HWPE 32	2018	Application of water resources management by using remote sensing and GIS	
	Professional Elective- IV				
11	Advanced Numerical Analysis	HWPE42	2018	Analysis and Design of FEM in flow through porous media.	
12	River Water Management	HWPE43	2018	Analysis and design of river water management.	
13	Computational Fluid Dynamics Lab	HWCP03	2018	Understand the computational concepts in pipe flow and channel flow by using different software's.	
14	Open Chanel Flow Lab	HWCP04	2018	Experimentation in flow through	

				open channel flows.	
15	Audit Course-II (Constitution of India)	PGPA21	2018	The intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.	
16	Pedagogy Studies	PGPA22	2018	The pedagogical practices being used by teachers in formal and informal classrooms in developing countries.	
17	Stress Management By Yoga	PGPA23	2018	Develop healthy mind in a healthy body thus improving social health also	
18	Personality Development Through Life Enlightenment Skills	PGPA24	2018	Develop personality and achieve the highest goal in life	
19	Mini Project	HWMP01	2018	Identify Water resources engineering problems reviewing available literature	
	III Semester				
	Professional Elective- V				
20	Climate Change and Sustainable Development	HWPE54	2019	Analyse the Climate change condition in sustainable manner.	
	Open Elective- I				

21	Business Analytics	HWOE11	2019	Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.	
22	Industrial Safety	HWOE12	2019	Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.	
23	Operations Research	HWOE13	2019	Students should able to apply the dynamic programming to solve problems of discreet and Continuous variables.	
24	Cost Management of Engineering Projects	HWOE14	2019	Students should able to apply the dynamic programming to solve problems of discreet and Continuous variables.	
25	Composite Materials	HWOE15	2019	Students should able to apply the concept of non-linear programming	
26	Energy Generation from Waste	HWOE16	2019	Demonstrate the energy generation from wastes	
27	Major project: Phase-I	HWPD01	2019	Identify Water resources	

	Dissertation			engineering problems reviewing available literature. Identify appropriate techniques to analyze complex structural systems.	
	IV Semester				
28	Major project: Phase-II Dissertation	HWPD02	2019	Solve complex Water resources system problems by applying appropriate techniques and tools.	

Table. 1.3.1. Courses which Professional Ethics, Gender, Human values, Environment and Sustainability into the curriculum.

A. Professional Ethics:

Programme name	Programme code	Course name	Course code	Year of Introduction	Description of the course addressing Professional Ethics
M.Tech H&WRE	1-1422777040	--	--	--	

B. Gender:

Programme name	Programme code	Course name	Course code	Year of Introduction	Description of the course addressing Professional Ethics
M.Tech H&WRE	1-1422777040	--	--	--	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18)

C. Human values:

Programme name	Programme code	Course name	Course code	Year of Introduction	Description of the course addressing Professional Ethics
M.Tech H&WRE	1-1422777040	Value Education	PGPA14	2018	

D. Environmental & Sustainability:

Programme name	Programme code	Course name	Course code	Year of Introduction	Description of the course addressing Professional Ethics
M.Tech H&WRE	1-1422777040	Energy Generation from Waste	HWOE16	2019	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
Postgraduate Programme
M.Tech Scheme of Instruction for Choice Based Credit System
(With effect from 2023-24 admitted batch)
Total credits (2 year course): 81

SCHEME: 2023-2024

SEMESTER I

Course Code	Course Title	L	T	P	Total	Credits	Sectional	End Semester	Total
COPC01	Mathematical Foundation of Computer Science	3	1	0	4	4	40	60	100
COPC02	AdvancedData Structures	3	1	0	4	4	40	60	100
COPC03	Advanced Operating Systems	3	1	0	4	4	40	60	100
COPE 1	Programme Elective-I	3			3	3	40	60	100
COPE11	**Machine Learning**								
COPE12	Data Preparation and Analysis								
COPE 2	Programme Elective-II	3			3	3	40	60	100
COPE21	**Distributed Databases**								
COPE22	Digital Forensics								
COCP 01	Core-I Lab:			3	3	1.5	40	60	100
COEP 01	Elective-I Lab			3	3	1.5	40	60	100
PGPC 01	Research Methodology and IPR	3	0	0	3	3	40	60	100
Total		18	3	6	27	24	320	480	800

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
Postgraduate Programme
M.Tech Scheme of Instruction for Choice Based Credit System
(With effect from 2023 – 2024 admitted batch)

SEMESTER II

Course Code	Course Title	L	T	P	Total	Credits	Seasonal	End Semester	Total
COPC 04	Advance Algorithms	3	1	0	4	4	40	60	100
COPC 05	Compilers for HPC	3	1	0	4	4	40	60	100
COPE 3	Programme Elective-III	3	0	0	3	3	40	60	100
COPE31	**Big Data Analytics**								
COPE32	Recommender System								
COPE 4	Programme Elective-IV	3	0	0	3	3	40	60	100
COPE41	Computer Vision								
COPE42	Introduction to Intelligent Systems								
COCP02	Core-II Lab			3	3	1.5	40	60	100
COEP02	Elective-II Lab			3	3	1.5	40	60	100
PGPC02	Cyber Security	0	0	4	2	2	100	-	100
COMP 01	Mini Project with seminar	1		4	5	4	100	-	100
		15	2	10	27	23	440	360	800

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
Postgraduate Programme
M.Tech Scheme of Instruction for Choice Based Credit System
(With effect from 2023– 2024 admitted batch)

SEMESTER III

Course Code	Course Title	L	T	P	Credits	Sessional	End Semester	Total
COP1	Internship/Mini Project (Min 4 Weeks)	0			3	100		100
PGOE 11	MOOCs	0	0	0	3	100		100
PGOE111	Block chain Technology							
PGOE112	IoT							
PGOE113	Mobile Netwoks							
PGOE114	Network Security							
PGOE115	Any other in Current Technology							
COPD01	Dissertation-Phase-I			24	12	40	60	100
Total		0	0	24	18	240	60	300

- Courses selected under Moocs should not be same as Core and Electives

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
Postgraduate Programme
Scheme of Instruction for Choice Based Credit System
(With effect from 2023 – 2024 admitted batch)

SEMESTER IV

		L	T	P	Credits	Sessional	End Semester	Total
COPD 02	Dissertation-Phase-II			20	16	40	60	100
	Total			20	16	100		100

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI
DEPARTMENT OF COMPUTER SCINCE ENGINEERING
Postgraduate Programme
M.Tech Scheme of Instruction for Choice Based Credit System
(With effect from 2023 – 2024 admitted batch)

SEMESTER I

PROGRAMME CORE

CourseCode	COPC 01
CourseName	MathematicalFoundationofComputerScience
Credits	3
Pre-Requisites	DiscreteMathematics

TotalNumberofLectures:48

COURSEOBJECTIVE
• To understand the mathematical fundamentals that is prerequisites for avariety of courseslike Data mining, Network protocols, analysis ofWeb traffic, Computer security, Softwareengineering,Computerarchitecture,operatingsystems,distributedsystems,Bioinformatics, Machinelearning.
• Todeveloptheunderstandingofthemathematicaland logicalbasistomanymodern techniques in information technology like machine learning, programming language design,and concurrency.
• Tostudyvarioussamplingandclassificationproblems.

LECTUREWITHBREAKUP	**NO. OF LECTURES**
Unit1 Probabilitymass,density,andcumulativedistributionfunctions,Parametricfamiliesof distributions,Expectedvalue,variance,conditionalexpectation,Applicationsoftheuni variateandmultivariateCentralLimitTheorem, Probabilisticinequalities,Markovchains	10
Unit2 Randomsamples,samplingdistributionsofestimators,MethodsofMomentsandMaximumLikelihood,	9
Unit3 Statistical inference, Introduction to multivariate statistical models: regression andclassificationproblems,principalcomponentsanalysis,Theproblemofoverfitting modelassessment.	8
Unit4 GraphTheory:Isomorphism,Planargraphs,graphcolouring,hamiltoncircuitsandeulercycles. Permutations and Combinations with and without repetition.Specializedtechniquestosolvecombinatorialenumerationproblems	11
Unit5 **Computerscienceandengineeringapplications**	10

Datamining,Networkprotocols,analysisofWebtraffic,Computersecurity, Softwareengineering,Computerarchitecture,operatingsystems,distributedsystems,Bioinformatics,Machinelearning.	
COURSEOUTCOMES	
Aftercompletion ofcourse,studentswould beableto:	
• Tounderstandthebasicnotionsofdiscreteand continuousprobability.	
• Tounderstandthemethodsofstatisticalinference,and therolethatsamplingdistributionsplayinthosemethods.	
• To be able to perform correct and meaningful statistical analyses of simple to moderatecomplexity.	

References

1. JohnVince,FoundationMathematicsforComputerScience,Springer.
2. K.Trivedi.ProbabilityandStatisticswithReliability,Queuing,andComputerScienceApplications.Wiley.
3. M.MitzenmacherandE.Upfal.ProbabilityandComputing:RandomizedAlgorithmsandProbabilistic Analysis.
4. AlanTucker, AppliedCombinatorics,Wiley

CourseCode	COPC 02
CourseName	AdvancedDataStructures
Credits	3
Pre-Requisites	UGlevelcourseinDataStructures

TotalNumberofLectures:48

COURSEOBJECTIVE
• The student should be able to choose appropriate data structures, understand theADT/libraries,anduseittodesign algorithms foraspecificproblem.
• Studentsshould beabletounderstandthenecessarymathematicalabstraction tosolveproblems.
• Tofamiliarizestudentswithadvancedparadigmsanddatastructureusedtosolvealgorithmicprobl ems.
• Student should beabletocomeupwithanalysisofefficiencyand proofsofcorrectness.

LECTUREWITHBREAKUP	**NO. OF LECTURES**
Unit1 **Dictionaries:**Definition,DictionaryAbstractDataType,ImplementationofDictionaries . **Hashing:**ReviewofHashing,HashFunction,CollisionResolutionTechniquesin Hashing,SeparateChaining,OpenAddressing,LinearProbing,QuadraticProbing,Doubl eHashing,Rehashing,ExtendibleHashing.	9
Unit2 **SkipLists:**Need forRandomizingDataStructuresand Algorithms,Searchand UpdateOperationsonSkipLists,ProbabilisticAnalysisofSkipLists,DeterministicSkip Lists	8
Unit3 **Trees:**BinarySearchTrees,AVLTrees,RedBlackTrees,2-3Trees,B-Trees,SplayTrees	9
Unit4	12
TextProcessing: StingOperations,Brute-ForcePatternMatching,TheBoyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, CompressedTries,SuffixTries,TheHuffmanCodingAlgorithm,TheLongestCommon SubsequenceProblem (LCS),ApplyingDynamicProgrammingtotheLCSProblem.	
Unit5 **ComputationalGeometry:**OneDimensionalRangeSearching,TwoDimensionalRange Searching,ConstructingaPrioritySearchTree,SearchingaPrioritySearch Tree,PriorityRangeTrees,Quadtrees,k-DTrees.	10

COURSEOUTCOMES
Aftercompletion ofcourse,studentswould beableto:
• Understandtheimplementationofsymboltable usinghashingtechniques.
• Developandanalyzealgorithmsforred-blacktrees, B-treesandSplaytrees.
• Developalgorithmsfortextprocessingapplications.
• Identifysuitabledatastructuresanddevelopalgorithmsforcomputationalgeometrypro blems.

References:

1. MarkAllenWeiss,DataStructuresand AlgorithmAnalysisinC++,2ndEdition,Pearson,2004.
2. M TGoodrich,RobertoTamassia,AlgorithmDesign,John Wiley,2002.

CourseCode	COPC 03
CourseName	Advanced OperatingSystem
Credits	3
Pre-Requisites	DataStructure,Algorithms,ComputerArchitectureandOrganization

TotalNumberofLectures:48

COURSEOBJECTIVE
• Theobjectiveofthecourseistoprovideintroductiontooperatingsystemdesignandconceptofprocess, processlifecycleandschedulingapproaches.

LECTUREWITHBREAKUP	**NO.OF LECTURES**
Unit1: Computersystem andoperatingsystem overview,Operatingsystem functionsanddesign issues,Designapproaches,Typesofadvanced operatingsystems.	10
Unit2: Processabstraction,Processmanagement,systemcalls,Threads,Symmetricmultiprocessingandmicro-kernels.	8
Unit3: Scheduling: Uniprocessor, Multiprocessor and Real time systems, concurrency, classical problems, mechanisms for synchronization:semaphores,monitors,Processdeadlockanddeadlock handlingstrategies.	10
Unit4: Memory management, Virtual memory concept, Virtual machines, I/O management,Fileanddiskmanagement,Operatingsystemsecurity.	9
Unit5: Distributed Operating system:Architecture, Design issues, Distributed mutualexclusion,Distributeddeadlockdetection,sharedmemory,Distributedscheduling.Multiprocessoroperatingsystems:architecture,operatingsystemdesignissues, threads, processsynchronization,processscheduling,memory management,reliabilityand faulttolerance.	11

COURSEOUTCOMES
Aftercompletion ofcourse,studentswouldbe:
• Understandingadvancedconceptsinoperatingsystems.
• LearningprinciplesofDistributedandmultiprocessoroperatingsystems

References:

1. Advancedconceptinoperatingsystem:M.Singhal,N.G.Shivratri
2. Operatingsysteminternalanddesignprinciples: WilliamStallings

PROGRAMME ELECTIVE-I TotalNumberofLectures:48

CourseCode	COPE 11
CourseName	Machinelearning
Credits	3
Pre-Requisites	
COURSEOBJECTIVE	
• Tolearntheconceptofhowtolearnpatternsandconceptsfromdata withoutbeingexplicitlyprogrammed invarious IOTnodes.	
• To design and analyse various machine learning algorithms and techniques with a modernoutlookfocusing onrecentadvances.	
• Exploresupervisedandunsupervisedlearningparadigmsofmachinelearning.	
• ToexploreDeep learningtechniqueand variousfeatureextractionstrategies.	
LECTUREWITHBREAKUP	**NO. OF LECTURES**
Unit1: **SupervisedLearning(Regression/Classification)** • Basicmethods:Distance-basedmethods,Nearest-Neighbours,DecisionTrees,NaiveBayes	10
• Linear models: Linear Regression, Logistic Regression, Generalized LinearModels • Support VectorMachines,Nonlinearityand KernelMethods • BeyondBinaryClassification:Multi-class/StructuredOutputs,Ranking	
Unit2: **UnsupervisedLearning** • Clustering:K-means/KernelK-means • DimensionalityReduction:PCAand kernelPCA • MatrixFactorizationandMatrixCompletion • GenerativeModels(mixturemodelsandlatentfactormodels)	9
Unit3 EvaluatingMachineLearningalgorithmsandModelSelection,IntroductiontoStatistical LearningTheory,EnsembleMethods(Boosting,Bagging,Random Forests)	9
Unit4 SparseModelingandEstimation,ModelingSequence/Time-SeriesData,DeepLearningandFeatureRepresentationLearning	9
Unit5 ScalableMachineLearning(OnlineandDistributedLearning) Aselectionfromsomeotheradvancedtopics,e.g.,Semi-supervisedLearning, ActiveLearning,ReinforcementLearning,InferenceinGraphicalModels,Introduction toBayesianLearningandInference	9
COURSEOUTCOMES	
Aftercompletion ofcourse,studentswouldbeableto:	
• Extract features that can be used for a particular machine learning approach in various IOTapplications.	
• To compare and contrast pros and cons of various machine learning techniques and to get aninsight ofwhentoapplyaparticularmachinelearning approach.	
• Tomathematicallyanalysevariousmachinelearningapproachesand paradigms.	

References:1 KevinMurphy,MachineLearning:AProbabilisticPerspective,MITPress,2012

2 TrevorHastie,RobertTibshirani,JeromeFriedman,TheElementsofStatisticalLearning,Springer2009(freelyavailableonline)

3 ChristopherBishop,PatternRecognitionandMachineLearning,Springer,2007.

CourseCode	COPE12
CourseName	DataPreparationandAnalysis
Credits	3
Pre-Requisites	

TotalNumberofLectures:48

COURSEOBJECTIVE
• Topreparethedataforanalysisanddevelopmeaningful DataVisualizations

LECTUREWITHBREAKUP	**NO.OFL ECTURES**
Unit1: **DataGatheringandPreparation:** Dataformats,parsingandtransformation, Scalabilityandreal-timeissues	9
Unit2: **Data Cleaning:** Consistencychecking,Heterogeneousandmissingdata,DataTransformationandsegmentation	11
Unit3: **ExploratoryAnalysis:** Descriptiveandcomparativestatistics,Clusteringandassociation,Hypothesisgeneration	13
Unit4: **Visualization:** Designingvisualizations,Timeseries,Geolocateddata,Correlationsandconnections, Hierarchiesandnetworks,interactivity	10
Unit5: **Current trends**	5

COURSEOUTCOMES
Aftercompletion ofcourse,studentswouldbe:
• Abletoextractthedatafor performingtheAnalysis.

References:

1.MakingsenseofData:A practical Guide toExploratoryDataAnalysisandDataMining,byGlenn J.Myatt

PROGRAMME ELECTIVE-II

CourseCode	COPE 21
CourseName	DistributedDatabase
Credits	3
Pre-Requisites	

TotalNumberofLectures:48

COURSEOBJECTIVE
• Theobjectiveofcourseistoprovideinsighttodistributeddatabase,normalizationtechniquesandintegrityrules.Italsoincludesparalleldatabase systemsalongwithobjectorientedmodels.

LECTUREWITHBREAKUP	**NO. OF LECTURES**
Unit1: Introduction: Distributed Data processing, Distributed database system (DDBMS),PromisesofDDBMSs,ComplicatingfactorsandProblemareasinDDBMSs,OverviewOfRelationalDBMSRelationalDatabaseconcepts,Normalization, Integrityrules,RelationalDataLanguages,RelationalDBMS.	11
Unit2: Distributed DBMS Architecture: DBMS Standardization, Architectural models forDistributed DBMS, Distributed DBMS Architecture. Distributed Database Design:AlternativedesignStrategies,Distributiondesignissues,Fragmentation,Allocation.SemanticDataControl:ViewManagement,Datasecurity,Semantic	10
IntegrityControl.	
Unit3: OverviewofQueryProcessing:Queryprocessingproblem,ObjectivesofQueryProcessing, Complexity of Relational Algebra operations, characterization of Queryprocessors,Layers ofQueryProcessing. Introduction to Transaction Management: Definition of Transaction, Properties oftransaction, types of transaction. Distributed Concurrency Control: Serializabilitytheory,Taxonomyofconcurrencycontrolmechanisms,lockingbasesconcurrency controlalgorithms.	9
Unit4: Parallel Database Systems: Database servers, Parallel architecture, Parallel DBMStechniques,Parallelexecutionproblems,Parallelexecutionforhierarchicalarchitecture.	10
Unit5: Distributed Object Database Management systems: Fundamental Object conceptsandObjectmodels,Objectdistributiondesign.Architecturalissues,Objectmanagement,Distributedobjectstorage,Objectqueryprocessing.Transactionmanagement.DatabaseInteroperability:DatabaseIntegration,Queryprocessing.	8

COURSEOUTCOMES
Aftercompletionofcourse,studentswouldbe:
• Abetounderstandrelationaldatabasemanagementsystems,normalizationtomakeefficient retrievalfromdatabaseandquery.

References:

1.PrinciplesofDistributedDatabaseSystems,SecondEdition,M.TamerOzsuPatrickValduriez

2.DistributedDatabasesprinciplesandsystems,StefanoCeri,GiuseppePelagatti,TataMcGrawHill.

CourseCode	COPE 22
CourseName	DigitalForensics
Credits	3
Pre-Requisites	CybercrimeandInformationWarfare, ComputerNetworks

TotalNumberofLectures:48

COURSEOBJECTIVE
• Providesanin-depthstudyofthe rapidlychangingandfascinating fieldofcomputerforensics.
• Combines both the technical expertise and the knowledge required to investigate, detectandpreventdigitalcrimes.
• Knowledge on digital forensics legislations, digital crime, forensics processes andprocedures,dataacquisitionandvalidation,e-discoverytools
• E-evidence collection and preservation, investigating operating systems and file systems,networkforensics,artofsteganographyandmobiledeviceforensics

LECTUREWITHBREAKUP	**NO.OFL ECTURES**
Unit1: **DigitalForensicsScience:**Forensicsscience,computerforensics,anddigitalforensics. **ComputerCrime:**Criminalisticsasitrelatestotheinvestigativeprocess,analysisofcyber-criminalisticsarea,holisticapproachtocyber-forensics	9
Unit2: **Cyber Crime Scene Analysis:** Discuss the various court orders etc., methods tosearchandseizureelectronicevidence,retrievedandun-retrievedcommunications,Discusstheimportanceofunderstandingwhatcourt documentswould berequired foracriminalinvestigation.	10
Unit3: **Evidence Management&Presentation:** Create and manage shared foldersusing operating system, importance of the forensic mindset, define the workloadof law enforcement, Explain what the normal case would look like, Define whoshouldbenotifiedofacrime,partsofgatheringevidence,Defineandapply probablecause.	9
Unit4: **ComputerForensics:**Prepareacase,Begininvestigation,Understandcomputerforensicsworkstationsandsoftware,Conductaninvestigation,Complete acase,Critiquea case, **Network Forensics:** open-source security tools for network forensic analysis,requirementsforpreservationofnetworkdata.	10
Unit5: **MobileForensics:**mobileforensicstechniques,mobileforensicstools. **LegalAspectsofDigitalForensics:**ITAct2000,amendmentofITAct 2008.	10

COURSEOUTCOMES
Aftercompletion ofcourse, studentswould beableto:
• Understandrelevantlegislationandcodesofethics
• Computer forensicsanddigitaldetectiveandvariousprocesses, policiesandprocedures
• E-discovery,guidelinesandstandards,E-evidence,toolsandenvironment.
• Emailandwebforensicsandnetworkforensics

References:1 JohnSammons,TheBasicsofDigitalForensics,Elsevier

2 JohnVacca,ComputerForensics:ComputerCrimeSceneInvestigation,LaxmiPublications

1. gn,JohnWilley,2002.

CourseCode	PGPC 01
CourseName	**ResearchMethodologyandIPR**
Credits	3

ResearchMethodologyandIPR

TeachingScheme

Lectures:1hrs/week

nation, it is needless to emphasis the need of information about Intellectual Property Righttobe promotedamongstudentsingeneral&engineeringinparticular.

- Understand that IPR protection provides an incentive to inventors for further research workand investment in R & D, which leads to creation of new and better products, and in turnbringsabout,economic growthandsocialbenefits.
-

SyllabusContents:

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics ofa good research problem, Errors in selecting a research problem, Scope and objectives ofresearchproblem.

Approachesofinvestigationofsolutionsforresearchproblem,datacollection,analysis,interpretation, Necessaryinstrumentations

Unit2: Effective

literaturestudiesapproaches,analysisPlagiarism,Researchet

hics,

Unit 3: Effectivetechnicalwriting, howtowritereport,Paper

Developing a Research Proposal,Formatof research proposal,a presentation and assessmentbyareviewcommittee

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process ofPatentingandDevelopment:technologicalresearch,innovation,patenting,development.Internati onal Scenario: International cooperation on Intellectual Property. Procedure for grantsofpatents,PatentingunderPCT.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patentinformationanddatabases.GeographicalIndications.

Unit 6: New Developments in IPR: Administration of Patent System. New developments inIPR;IPRofBiologicalSystems,ComputerSoftwareetc.TraditionalknowledgeCaseStudies,IPRandIITs.

References:

- StuartMelvilleandWayneGoddard,"Researchmethodology:anintroductionforscience&engineeringstudents'"
- WayneGoddardandStuartMelville,"ResearchMethodology:AnIntroduction"
- RanjitKumar,2ndEdition,"ResearchMethodology:AStepbyStepGuideforbeginners"
- Halbert, "ResistingIntellectualProperty",Taylor &FrancisLtd,2007.
- Mayall,"IndustrialDesign",McGrawHill,1992.
- Niebel,"Product Design",McGrawHill,1974.
- Asimov,"IntroductiontoDesign", PrenticeHall, 1962.
- RobertP.Merges,PeterS.Menell,MarkA.Lemley,"IntellectualPropertyinNewTechnological Age",2016.
- T.Ramappa,"IntellectualPropertyRightsUnder WTO",S.Chand, 2008

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI
DEPARTMENT OF COMPUTER SCINCE ENGINEERING
Postgraduate Programme
M.Tech Scheme of Instruction for Choice Based Credit System
(With effect from 2023-24 admitted batch)

SEMESTER II

PROGRAMME CORE

CourseCode	COPC 04
CourseName	AdvancedAlgorithms
Credits	3
Pre-Requisites	UGlevelcoursein AlgorithmDesign and Analysis

TotalNumberofLectures:48

COURSEOBJECTIVE
• Introducestudentstotheadvancedmethodsofdesigningandanalyzingalgorithms.
• Thestudent should beabletochooseappropriatealgorithmsanduseit foraspecificproblem.
• Tofamiliarizestudentswithbasicparadigmsanddatastructuresused tosolveadvancedalgorithmicproblems.
• Studentsshouldbeabletounderstanddifferentclassesofproblemsconcerningtheircomp utationdifficulties.
• Tointroducethestudents torecent developments in theareaofalgorithmicdesign.

LECTUREWITHBREAKUP	**NO. OF LECTURES**
Unit1 **Sorting:**Review ofvarioussortingalgorithms,topologicalsorting **Graph:** DefinitionsandElementaryAlgorithms:ShortestpathbyBFS,shortestpathinedge-weightedcase (Dijkasra's),depth-firstsearchandcomputationofstronglyconnectedcomponents,emphasisoncorrectness proofofthealgorithm andtime/spaceanalysis,exampleofamortizedanalysis.	9
Unit2 **Matroids:** Introductiontogreedyparadigm,algorithmtocomputeamaximumweight maximalindependentset.ApplicationtoMST. **GraphMatching:**Algorithmtocomputemaximummatching.Characterizationofmaximummatchingbyaugmentingpaths,Edmond'sBlossomalgorithmto computeaugmentingpath.	10

Unit3 **Flow-Networks:**Maxflow-mincuttheorem,Ford-FulkersonMethodtocomputemaximumflow,Edmond-Karpmaximum-flowalgorithm. **MatrixComputations:**Strassen'salgorithmandintroductiontodivideandconquerparadigm,inverseofatriangularmatrix,relationbetweenthetime complexitiesofbasicmatrixoperations,LUP-decomposition.	9
Unit4 **Shortest Path in Graphs:** Floyd-Warshall algorithm and introduction to dynamicprogrammingparadigm.Moreexamples ofdynamicprogramming. **Modulo Representation of integers/polynomials:** Chinese Remainder Theorem,Conversion between base-representation and modulo-representation. Extension topolynomials.Application:Interpolationproblem. **DiscreteFourierTransform(DFT):**Incomplexfield,DFTinmoduloring.Fast FourierTransformalgorithm.Schonhage-StrassenIntegerMultiplicationalgorithm	10
Unit5 **LinearProgramming:**GeometryofthefeasibilityregionandSimplexalgorithm **NP-completeness:**Examples,proofofNP-hardnessandNP-completeness. **Oneormoreofthefollowingtopicsbasedon timeandinterest** ApproximationalgorithmsRandomizedAlgorithms,InteriorPointMethod,Advanced NumberTheoreticAlgorithm	10

COURSEPOUTCOMES
Aftercompletion ofcourse,studentswould beableto:
• Analyzethecomplexity/performanceofdifferentalgorithms.
• Determinetheappropriatedatastructureforsolvingaparticularset ofproblems.
• Categorizethedifferentproblemsinvariousclassesaccordingtotheircomplexity.
• Studentsshouldhaveaninsightofrecentactivitiesinthefieldoftheadvanceddatastructure.

References:

1. "Introduction toAlgorithms"byCormen,Leiserson,Rivest,Stein.
2. "TheDesign andAnalysisofComputerAlgorithms"byAho,Hopcroft,Ullman.
3. "AlgorithmDesign"byKleinbergandTardos.

CourseCode	COPE 05
CourseName	Compilerfor HPC
Credits	3
Pre-Requisites	DataStructure,CompilerDesign,TheoryofComputation

TotalNumberofLectures:48

COURSEOBJECTIVE
• Theobjectiveofthiscourseistointroducestructureofcompilersandhighperformancecompilerdesign forstudents.Conceptsofcachecoherenceandparallelloopsincompilersare included.

LECTUREWITHBREAKUP	**NO.OFL ECTURES**
Unit1: **HighPerformanceSystems,**StructureofaCompiler,ProgrammingLanguageFeatures,LanguagesforHighPerformance.	9
Unit2: **Data Dependence:** Data Dependence in Loops, Data Dependence inConditionals, Data Dependence in Parallel Loops, Program Dependence Graph.**ScalarAnalysiswithFactoredUse-DefChains:**ConstructingFactoredUse-DefChains,FUDChainsforArrays,InductionVariablesUsingFUDChains,Constant PropagationwithFUDChains,DataDependenceforScalars.Data DependenceAnalysisforArrays.	10
Unit3: Array Region Analysis,PointerAnalysis,I/O Dependence,Procedure Calls,Inter-proceduralAnalysis. **LoopRestructuring:**SimpleTransformations,LoopFusion,LoopFission,LoopReversal,LoopInterchanging,LoopSkewing,LinearLoopTransformations, Strip-Mining, Loop Tiling, Other Loop Transformations, andInter-proceduralTransformations. **OptimizingforLocality:**SingleReferencetoEachArray,MultipleReferences, GeneralTiling, FissionandFusionfor Locality.	10
Unit4: **Concurrency Analysis:** Concurrency from Sequential Loops, Concurrency fromParallelLoops,NestedLoops,RoundoffError,ExceptionsandDebuggers. **VectorAnalysis:**VectorCode,VectorCodefromSequentialLoops,VectorCodefrom ForallLoops,NestedLoops, RoundoffError,Exceptions, and Debuggers,Multi-vectorComputers.	10
Unit5: **Message-PassingMachines:**SIMDMachines,MIMDMachines,DataLayout,ParallelCodefor ArrayAssignment,RemoteDataAccess,AutomaticData Layout,MultipleArrayAssignments,OtherTopics.	10
ScalableShared-MemoryMachines: GlobalCacheCoherence,LocalCache Coherence,LatencyTolerantMachines.	

COURSEOUTCOMES
Aftercompletion ofcourse,studentswouldbe:

• Familiarwiththestructureofcompiler. • Parallelloops, datadependencyandexceptionhandlinganddebuggingincompiler.

References:1.MichaelWolfe,High-PerformanceCompilersforParallelComputing,Pearson

PROGRAMME ELECTIVE- III

CourseCode	COPE31
CourseName	BigDataAnalytics
Credits	3
Pre-Requisites	DataStructure,ComputerArchitectureandOrganization

TotalNumberofLectures:48

COURSEOBJECTIVE
• Understandbigdataforbusinessintelligence.Learnbusinesscasestudiesforbigdataanalytics.Understandnosqlbigdatamanagement.Performmap-reduceanalyticsusingHadoopandrelated tools

LECTUREWITHBREAKUP	**NO. OFLECTURES**
Unit1: Whatisbigdata, whybigdata,convergenceofkeytrends, unstructureddata,industry examples of big data, web analytics, big data and marketing, fraud and bigdata, risk and big data, credit risk management, big data and algorithmic trading,big data and healthcare, big data in medicine, advertising and big data, big datatechnologies,introductiontoHadoop,opensourcetechnologies,cloudandbigdata, mobilebusinessintelligence,Crowdsourcinganalytics,interandtransfirewallanalytics .	8
Unit2: IntroductiontoNoSQL,aggregatedatamodels,aggregates,key-valueanddocumentdatamodels,relationships,graphdatabases,schemalessdatabases, materialized views, distribution models, sharding, master-slave replication, peer-peerreplication,shardingandreplication,consistency,relaxingconsistency,version stamps, map-reduce, partitioning and combining, composing map-reducecalculations.	8
Unit3: Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadooppipes,designofHadoopdistributedfilesystem(HDFS),HDFSconcepts,Javainterface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro,file-based datastructures	9
Unit4: MapReduce workflows, unit tests with MRUnit, test data and local tests, anatomy ofMapReduce job run, classic Map-reduce, YARN, failures in classic Map-reduce andYARN, job scheduling, shuffle and sort, task execution, MapReduce types, inputformats,outputformats	10
Unit5:	13
Hbase,datamodelandimplementations,Hbaseclients,Hbaseexamples,praxis.Cassandra, Cassandra data model, Cassandra examples, Cassandra clients,Hadoop integration. Pig,Grunt,pigdatamodel,PigLatin,developingandtestingPigLatinscripts. Hive,datatypes and fileformats,HiveQLdatadefinition,HiveQLdatamanipulation,HiveQL queries.	

COURSEOUTCOMES
Aftercompletionofcourse,studentswouldbe:
• Describebig dataand usecases fromselected business domains • ExplainNoSQLbigdatamanagement • Install,configure,andrunHadoopandHDFS • Performmap-reduceanalyticsusingHadoop • UseHadoop relatedtoolssuchasHBase,Cassandra,Pig,andHiveforbigdataanalytics

References:

1. MichaelMinelli,MichelleChambers,andAmbigaDhiraj,"BigData, BigAnalytics:Emerging
2. BusinessIntelligenceandAnalyticTrendsforToday'sBusinesses",Wiley,2013.
3. P.J.SadalageandM.Fowler,"NoSQL Distilled:A BriefGuidetotheEmergingWorld of
4. PolyglotPersistence",Addison-WesleyProfessional,2012.
5. TomWhite,"Hadoop:TheDefinitiveGuide",ThirdEdition,O'Reilley,2012.
6. EricSammer,"HadoopOperations",O'Reilley,2012.
7. E.Capriolo,D. Wampler,and J.Rutherglen,"ProgrammingHive",O'Reilley,2012.
8. LarsGeorge,"HBase:TheDefinitiveGuide",O'Reilley,2011.
9. EbenHewitt,"Cassandra:TheDefinitiveGuide",O'Reilley,2010.
10. AlanGates,"ProgrammingPig",O'Reilley,2011.

CourseCode	COPE32
CourseName	RecommenderSystem
Credits **Prerequisites**	3

TotalNumberofLectures:48

COURSEOBJECTIVE
• Tolearntechniquesformakingrecommendations,includingnon-personalized,content-based,and collaborativefiltering • To automate a variety of choice-making strategies with the goal of providing affordable, personal,and high-qualityrecommendations

LECTUREWITHBREAKUP	**NO. OFLECTURES**
Unit1: **Introduction:** Overview of Information Retrieval, Retrieval Models, Search andFiltering Techniques: Relevance Feedback, User Profiles, Recommender systemfunctions,Matrixoperations,covariancematrices,Understandingratings, Applicationsofrecommendationsystems,Issueswithrecommendersystem.	9
Unit2: **Content-basedFiltering:**Highlevelarchitectureofcontent-basedsystems,Advantages and drawbacks of content based filtering, Item profiles, Discoveringfeaturesofdocuments,pre-processingandfeatureextraction,Obtainingitem features from tags, Methods for learning user profiles, Similarity based retrieval,Classification algorithms.	8
Unit3: **CollaborativeFiltering:**User-basedrecommendation,Item-basedrecommendation,Modelbasedapproaches,Matrixfactorization,Attacksoncollaborativerecommendersystems.	9
Unit4: **Hybrid approaches:** Opportunities for hybridization, Monolithic hybridizationdesign:Featurecombination, Featureaugmentation,Parallelizedhybridizationdesign:Weighted,Switching,Mixed, Pipelinedhybridizationdesign:Cascade Meta-level,Limitationsofhybridizationstrategies	8
Unit5: **EvaluatingRecommenderSystem:**Introduction,Generalpropertiesofevaluation research, Evaluation designs: Accuracy, Coverage, confidence, novelty,diversity,scalability,serendipity,Evaluationonhistoricaldatasets,Offlineevaluations. **Types of Recommender Systems:** Recommender systems in personalized websearch,knowledge-basedrecommendersystem,Socialtaggingrecommendersystems,Trust-centricrecommendations,Group recommendersystems.	14

COURSEOUTCOMES
Aftercompletionofcourse, studentswould beableto:

- Designrecommendationsystemforaparticular applicationdomain.
- Evaluaterecommendersystemsonthebasisofmetricssuchasaccuracy,rankaccuracy,diversity,productcoverage,andserendipity

References:

1. JannachD.,ZankerM.andFelFeringA.,RecommenderSystems:AnIntroduction,CambridgeUniversityPress (2011),1sted.
2. CharuC.Aggarwal,RecommenderSystems:TheTextbook,Springer(2016),1sted.
3. RicciF.,RokachL.,ShapiraD.,KantorB.P.,RecommenderSystemsHandbook,Springer(2011),1sted.
4. ManouselisN.,DrachslerH.,VerbertK.,DuvalE.,RecommenderSystemsForLearning,Springer(2013),1sted.

PROGRAMME ELECTIVE-IV

CourseCode	COPE41
CourseName	ComputerVision
Credits	3
Pre-Requisites	Linearalgebra,vectorcalculus,DatastructuresandProgramming.

TotalNumberofLectures:48

COURSEOBJECTIVE
• Befamiliarwithboththetheoreticalandpracticalaspectsofcomputing withimages.
• Havedescribedthefoundationofimageformation,measurement,andanalysis.
• Understandthegeometricrelationshipsbetween2Dimagesandthe3Dworld.
• Graspthepprinciplesofstate-of-the-artdeep neuralnetworks.

LECTUREWITHBREAKUP	**NO.OFL ECTURES**
Unit1: Overview,computerimagingsystems,lenses,Imageformationandsensing,Imageanalysis,pre-processingandBinaryimageanalysis	10
Unit2: Edgedetection,Edgedetectionperformance,Houghtransform,cornerdetection	10
Unit3: Segmentation,Morphologicalfiltering,Fouriertransform	9
Unit4: Featureextraction,shape,histogram,color,spectral,texture,usingCVIPtools,Featureanalysis,featurevectors,distance/similaritymeasures,datapre-processing	10
Unit5: PatternAnalysis: Clustering:K-Means,K-Medoids,MixtureofGaussians Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised Classifiers:Bayes,KNN,ANNmodels;DimensionalityReduction:PCA,LDA,ICA,andNon-parametricmethods.	9

COURSEOUTCOMES
Aftercompletion ofcourse, studentswould beableto:
• Developedthepracticalskillsnecessarytobuildcomputervisionapplications.
• Tohavegainedexposuretoobjectandscenerecognitionandcategorizationfromimages.

References:

1. ComputerVision:AlgorithmsandApplicationsbyRichardSzeliski.
2. DeepLearning,byGoodfellow,Bengio,andCourville.
3. DictionaryofComputerVisionandImageProcessing,byFisheretal.

CourseCode	COPE42
CourseName	IntroductiontoIntelligentSystems
Credits	3
Pre-Requisites	DataStructuresand DataManagement orDataStructures

TotalNumberofLectures:48

COURSEOBJECTIVE	
• Theaimofthecourseistointroducetothefieldof ArtificialIntelligence(AI)withemphasisonitsusetosolverealworldproblemsforwhichsolutionsaredifficulttoexpressusingthetraditionalalgorithmicapproach.Itexplorestheessentialtheorybehindmethodologiesfordevelopingsystemsthatdemonstrateintelligentbehaviourincludingdealingwithuncertainty, learningfromexperienceandfollowingproblemsolvingstrategiesfoundinnature.	
LECTUREWITHBREAKUP	**NO.OF LECTURES**
Unit1: BiologicalfoundationstointelligentsystemsI:Artificialneuralnetworks,Back-propagationnetworks, Radialbasisfunctionnetworks, andrecurrentnetworks.	9
Unit2: BiologicalfoundationstointelligentsystemsII:Fuzzylogic,knowledgeRepresentation and inference mechanism, genetic algorithm, and fuzzy neuralnetworks.	8
Unit3: Search Methods Basic concepts of graph and tree search. Three simple searchmethods:breadth-firstsearch,depth-firstsearch,iterativedeepeningsearch.Heuristicsearchmethods:best-firstsearch,admissibleevaluationfunctions,hill-climbing search.Optimisationandsearchsuchasstochasticannealing and geneticalgorithm.	10
Unit4: KnowledgerepresentationandlogicalinferenceIssuesinknowledgerepresentation. Structured representation, such as frames, and scripts, semanticnetworksandconceptualgraphs.Formallogicandlogicalinference.Knowledge-basedsystemsstructures,itsbasiccomponents.IdeasofBlackboard architectures.	9
Unit5: ReasoningunderuncertaintyandLearningTechniquesonuncertaintyreasoningsuchasBayesianreasoning,CertaintyfactorsandDempster-ShaferTheoryof Evidentialreasoning,Astudyofdifferentlearningandevolutionaryalgorithms,suchasstatisticallearningandinductionlearning.	7

COURSEOUTCOMES
Aftercompletion ofcourse,studentswouldbe:
• Able to Demonstrate knowledge of the fundamental principles of intelligent systems andwould be able to analyse and compare the relative merits of a variety of AI problem solvingtechniques.

References:

1. LugerG.F.andStubblefieldW.A.(2008).ArtificialIntelligence:StructuresandstrategiesforComplexProblemSolving.AddisonWesley,6thedition.
2. RussellS.andNorvigP.(2009).ArtificialIntelligence:AModernApproach.Prentice-Hall,3rdedition.

CourseCode	PGPC 02
CourseName	Cyber Security
Credits	2
Pre-Requisites	Information Communication Technology

TotalNumberofLectures:48

COURSEOBJECTIVE

(a) LearnthefoundationsofCybersecurityandthreatlandscape.

(b) Toequipstudentswiththetechnicalknowledgeandskillsneededtoprotectanddefendagainstcyberthreats.

(c) Todevelopskillsinstudentsthatcanhelpthemplan,implement,andmonitorcybersecuritymechanismstoensuretheprotectionofinformationtechnologyassets.

(d) Toexposestudentstogovernance,regulatory,legal,economic,environmental,socialandethicalcontextsofcybersecurity.

(e) Toexposestudentstoresponsibleuseofonlinesocialmedianetworks.

(f))
Tosystematicallyeducatethenecessitytounderstandtheimpactofcybercrimesandthreatswithsolutionsinaglobalandsocietalcontext.

LECTUREWITHBREAKUP	**NO.OF LECTURES**
Unit1: Cyber security increasing threat landscape,Cyber security terminologies-Cyberspace,attack, attack vector, attack surface, threat,risk, vulnerability, exploit, exploitation,hacker., Non-state actors, Cyber terrorism,Protection of end user machine, CriticalIT and National Critical Infrastructure,Cyberwarfare,CaseStudies.	10
Unit2: Cyber crimes targeting Computer systemsandMobiles-datadiddlingattacks,spyware, logic bombs, DoS, DDoS, APTs,virus, Trojans, ransomware, data breach.,Online scams and frauds- email scams,Phishing,Vishing,Smishing,Onlinejobfraud,Onlinesextortion,Debit/credit card fraud, Online payment fraud,Cyberbullying,websitedefacement,Cyber-squatting,Pharming,Cyberespionage,Cryptojacking,Darknet-illegaltrades,drug trafficking, human trafficking., SocialMedia Scams & Frauds-impersonation,identitytheft,jobscams,misinformation,fake newscyber crime against persons -cyber grooming, child pornography, cyberstalking.,SocialEngineeringattacks,CyberPolicestations,Crimereporting procedure,Casestudies.	10
Unit 3: Cybercrimeandlegallandscapearound the world, IT Act,2000 and itsamendments.LimitationsofITAct,2000.Cybercrimeandpunishments,Cyber Laws and Legal and ethical aspectsrelated to new technologies- AI/ML, IoT,Blockchain,	10

Darknet and Social media,CyberLawsofothercountries,CaseStudies.	
Unit4: Defining data, meta-data, big data, non-personaldata.Dataprotection,Dataprivacy and data security, Personal DataProtection Bill and its compliance, Dataprotection principles, Big data securityissuesandchallenges,Dataprotectionregulations of other countries- GeneralData Protection Regulations(GDPR),2016PersonalInformationProtectionandElectronicDocumentsAct(PIPEDA).,Social media- data privacy and securityissues.	8
Unit5: Cyber security Plan- cyber security policy,cyber crises management plan., Businesscontinuity,Riskassessment,Typesofsecurity controls and their goals, Cybersecurity audit and compliance, Nationalcybersecuritypolicyandstrategy.	10

COURSEOUTCOMES

Oncompletionofthecoursethestudentshould beable to

(a) Understandthecybersecuritythreatlandscape.

(b) Developadeeperunderstandingandfamiliaritywithvarioustypesof cyberattacks,cybercrimes,vulnerabilitiesandremediesthereto.

(c) Analyseandevaluateexistinglegalframeworkandlawsoncybersecurity.

(d) Analyse and evaluate the digital payment systemsecurity and remedial measuresagainstdigitalpaymentfrauds.

(g) Analyseandevaluatetheimportanceofpersonaldataitsprivacyandsecurity.

(h)) Analyseandevaluatethesecurityaspectsofsocialmediaplatformsandethical aspectsassociatedwithuseofsocialmedia.

(i) Analyseandevaluatethecybersecurityrisks.

(j) BasedontheRiskassessment,plansuitablesecuritycontrols,auditandcompliance.

(k) Evaluateandcommunicatethehumanroleinsecuritysystemswithanemphasiso nethics,socialengineeringvulnerabilitiesandtraining.

(l) Increaseawarenessaboutcyber-attackvectorsandsafetyagainstcyber-frauds.

(m) Takemeasuresforself-cyber-protectionaswellassocietalcyber-protection.

References:

1. CyberSecurityUnderstandingCyberCrimes,ComputerForensicsandLegalPerspectivesbySumitBela pureandNinaGodbole,WileyIndiaPvt.Ltd.
2. Information WarfareandSecuritybyDorothyF.Denning,Addison Wesley.
3. SecurityintheDigitalAge:SocialMediaSecurityThreatsandVulnerabilitiesbyHenryA.Oliver,CreateS paceIndependentPublishingPlatform.
4. DataPrivacyPrinciplesandPracticebyNatrajVenkataramananandAshwinShriram,CRCPress.

5. InformationSecurityGovernance,GuidanceforInformationSecurityManagersby W.KragBrothy,1stEdition,WileyPublication

SRI VENKATESWARA UNIVERSITY: TIRUPATI
SVU COLLEGE OF ARTS
MA. WOMEN'S STUDIES AND MANAGEMENT
(Syllabus Common for S. V. University College and affiliated by SVU Area)
(Revised Scheme of Instruction and Examination, Syllabus etc., with effect from the Academic Year's 2021-22 for I and II Semesters and 2022-23 for III and IV Semesters)
Revised CBCS Pattern with effect from 2021-2022
SEMESTER-I

S.No	Components of Study	Paper Code SVUWS	Title of the paper	Contact hours	No. of Credit	IA Marks	End SEM Exam Marks	Total
1.	**Core** (Mandatory)	101	Introduction to Gender and Women's Studies	6	4	20	80	100
2.		102	Principles of Management with Gender Lens	6	4	20	80	100
3.		103	Gender, Patriarchy and Society	6	4	20	80	100
4.		104	Women's Movements: National and International Perspectives	6	4	20	80	100
5.	**Compulsory Foundation Opt -1**	105(a)	Environment: Gender and Livelihood Challenges	6	4	20	80	100
		105(b)	Social Process and Behavioral Issues: Gender Questions					
		105(c)	Education: Gender Achievements and Gaps					
6.	**Elective Foundation Opt -1**	106(a)	Gender Sensitization and Training: Needs and Strategies	6	4	20	80	100
		106(b)	Communication, Soft Skills and Etiquette					
			Total	**36**	**24**	**120**	**480**	**600**
	Audit course		Human Values and Professional Ethics –I	0	0	100	-	-

- ❖ All CORE Papers are Mandatory
- ❖ Compulsory Foundation- Choose one paper
- ❖ Elective Foundation - Choose one paper
- ❖ Audit course-100 Marks (Internal) Zero credits under self-study
- ❖ Interested Students may Register for MOOC with the approval of the concerned DDC but it will be considered for the award of the grade as open elective only giving extra credits

SEMESTER-II

S.No	Components of Study	Paper Code	Title of the paper	Contact hours	No. of Credit	IA Marks	End SEM Exam Marks	Total
1.	**Core** (Mandatory)	201	Development – Gender Perspectives	6	4	20	80	100
2.		202	Health and Nutrition: Gender Analysis	6	4	20	80	100
3.		203	NGO Management and Social Development	6	4	20	80	100
4.		204	Policies and Programmes for Women's Development	6	4	20	80	100
5.	**Compulsory Foundation Opt -1**	205(a)	Media and Governance: Gender Concerns	6	4	20	80	100
		205(b)	Gender Identity and Leadership: Needs and Strategies					
		205(c)	Gender Based Violence: Issues and Concerns					
6.	**Elective Foundation Opt -1**	206 (a)	Human Rights with Gender Lens	6	4	20	80	100
		206(b)	Financial Literacy and Management					
			Total	**36**	**24**	**120**	**480**	**600**
	Audit course		Human Values and Professional Ethics –II	0	0	100	-	-

- ❖ All CORE Papers are Mandatory
- ❖ Compulsory Foundation - Choose one paper
- ❖ Elective Foundation - Choose one paper

- Audit course- 100 Marks (Internal) Zero credits under self-study
- Interested Students may Register for MOOC with the approval of the concerned DDC but it will be considered for the award of the grade as open elective only giving extra credits

SEMESTER-III

S.No	Components of Study	Paper Code	Title of the paper	Contact hours	No. of Credit	IA Marks	End SEM Exam Marks	Total
1.	**Core**	301	Feminist Theories	6	4	20	80	100
2.		302	Research Methods and Statistics: Feminist Concerns	6	4	20	80	100
3	**Generic Elective Opt -2**	303(a)	Capacity Building and Leadership: Gender Questions	6	4	20	80	100
		303(b)	Guidance and Counseling with Gender Perspectives					
		303(c)	Human Resource Management : Gender Analysis	6	4	20	80	100
		303(d)	Women, Science and Technology: Gender Biases and Strategies					
4	**Skill oriented course** (Mandatory)	304	Computer Applications and Software Packages for Data Analysis	6	4	20	80	100
5.	**Open Elective Opt -1**	305(a)	Social Values and Ethics : Gender Concerns	6	4	20	80	100
		305(b)	Governance: Gender Issues and Challenges.					
			Total	**36**	**24**	**120**	**480**	**600**

- All CORE Papers are Mandatory
- Generic Elective- choose two
- Skill oriented course (Mandatory)
- Open Elective for the Students of other Departments. Minimum One Paper should be opted.
- Extra credits may be earned by opting for more number of Open Electives depending on the Interest of the student through self-study.
- Interested students may register for MOOC with the approval of the concerned DDC

SEMESTER-IV

S.No	Components of Study	Paper Code	Title of the paper	Contact hours	No. of Credit	IA Marks	End SEM Exam Marks	Total
1.	**Core**	401	Entrepreneurship Development: Gender Analysis	6	4	20	80	100
2..		402	Women's Legislations – Gender Concerns	6	4	20	80	100
3	**Generic Elective Opt -2**	403(a)	Participatory Learning, Methods and Extension Education	6	4	20	80	100
		403(b)	Social Structure: Gender Biases and Questions	6	4	20	80	100
		403(c)	Women's Health: A Life Cycle Approach					
		403(d)	Globalization: Gender Implications					
4	**Multi-disciplinary Course/Project work**	404	Project Work	6	4	20	80	100
5.	**Open Elective Opt -1**	405(a)	Media and Communication: Gender Concerns	6	4	20	80	100
		405(b)	Women and Work: Gender Questions					
			Total	**36**	**24**	**120**	**480**	**600**

- All CORE Papers are Mandatory
    - Generic Elective- choose two
- Skill oriented course (Mandatory)
- Open Elective for the Students of other Departments. Minimum One Paper should be opted.
- Extra credits may be earned by opting for more number of Open Electives depending on the Interest of the student through self-study.

- Interested students may register for MOOC with the approval of the concerned DDC

*****

DEPARTMENT OF GEOLOGY
SRI VENKATESWARA UNIVERSITY-TIRUPATI-517502, A.P

PROCEEDINGS OF THE BOARD OF STUDIES (BoS) MEETING

The BoS Committee **Meeting held online** on 08-12-2021 at 11.00 AM to discuss for the Revision of P.G. Degree Programme (CBCS) Regulations - 2016; Amended as per NEP – 2021 (with effect from the batch admitted in the Academic Year 2021-2022). The following members were present.

1	Dr. U. Suresh	Chairman-in charge, BoS
2	Dr. T. Madhu	Ex-Officio Member
3	Dr. V. Gope Naik	Member
4	Prof. T. Ramkumar	External Member
5	Prof. K. Sathyanarayana Reddy	External Member

All the members of the BoS Committee in its meeting thoroughly discussed for the Revision of P.G. Degree Programme (CBCS) Regulations – 2016; Amended as per NEP – 2021 and prepared the Curriculum and detailed Syllabi with updated references for M.Sc. Geology Course of Sri Venkateswara University, Tirupati.

The Total number of Credits, Scheme of Instruction and Examinations, Syllabi for Core, Compulsory Foundation, Elective Foundation, Generic Elective, Skill Oriented Course, Multi-disciplinary Course and Audit Course are Discussed and Approved the Revision of P.G. Degree Programme (CBCS) Regulations - 2016; Amended as per NEP – 2021 (with effect from the batch admitted in the Academic Year 2021-2022) for M.Sc. Geology Course of S.V. University, Tirupati.

1.	Dr. U. Suresh	Chairman-in charge, BoS
2.	Dr. T. Madhu	Ex-Officio Member
3.	Dr. V. Gope Naik	Member
4.	Prof. T. Ramkumar	External Member
5.	Prof. K. Sathyanarayana Reddy	External Member

HEAD
Department of Geology

Programme Code	Programme name	Year of Introduction	Status of implementation of CBCS/Elective Course System (ECS)	Year of implementation of CBCS/ECS	Year of revision (ifany)	If revision has been carried out in the syllabus duringthelast5 years, Percentage of Content added or replaced	Link to the relevant documents
			CBCS: Yes/No ECS:Yes/No	CBCS: ECS:	CBCS: ECS:	CBCS: ECS:	CBCS: ECS:
Geo 224	M.Sc. Geology	2021	CBCS:NEP	CBCS:NEP 2021	CBCS : NEP - 2020 ECS : NEP - 2020	25%	enclosed

SRI VENKATESWARA UNIVERSITY:: TIRUPATI

SVU COLLEGE OF SCIENCES

DEPARTMENT OF GEOLOGY

Syllabus for M.Sc. GEOLOGY

Choice Based Credit System (CBCS)

(w.e.f. the Academic Year 2021-2022)

DEPARTMENT OF GEOLOGY

S V U COLLEGE OF SCIENCES

SRI VENKATESWARA UNIVERSITY

TIRUPATI

P.G. DEGREE PROGRAMME (CBCS) REGULATIONS – 2016

AMENDED AS PER NEP – 2020

Vision of the Department

The Geology department of the University seeks to provide the highest levels of education through continuous revision and expansion of our educational, research, and outreach programs in order to produce well-trained, competent, academic and professional geoscientists capable of responding to societal needs.

Mission of the Department

The Geology Department will develop in each student, critical thinking, enthusiasm, initiative and the necessary skills to become lifelong students of Earth Sciences. Emphasis will be placed on learning basic concepts and techniques through research, in an environment that promotes the development of professionals with social, cultural and humanistic sensibility as well as profound ethical values. In this way, the department will contribute to the enrichment of science and society through the creation and dissemination of new knowledge through scientific research.

About the Program

Sri Venkateswara University offers M.Sc., Geology programme, under Choice Based Credit System (CBCS). The CBCS enables the

students to select choice of subjects as per her /his interest and requirement. Acquiring knowledge in the related discipline is advantageous to the students. The CBCS program is framed in such a way that to impart more Knowledge in the field of Geological sciences.

Geology is an inter-disciplinary subject which enables to understand the earth processes and its treasures. It incorporates inputs from almost all science disciplines. Geologists are mainly involved in the exploration and extraction of natural resources viz., minerals, rocks, fossil fuel and water. In the fast growing world geologists will have to play a vital role in building the nation. Geologists can also engage in geological research, which has immense potential in the current scenario.

PROGRAMME OBJECTIVES

1. Education and Training: Provide an excellent preparation for a career in professional practice in industrial or environmental Earth Sciences, research in Geosciences, and specialist areas of other physical and natural sciences.

2. Communication Skills: Skills to communicate in written, numerical, graphical and verbal forms, in ways that are appropriate to different audiences and indifferent situations, ranging from scientific and industry reports, to group and individual oral presentations, and from blogs and outreach articles, to news articles and essays.

3. Critical Thinking: Acquire an understanding of the concept in geology and related disciplines and an ability to understand, integrate, and extend it so that all fundamental geological concepts are accessible.

4. Problem Solving: Skills to recognise and articulate a problem and then apply appropriate conceptual frameworks and methods to solve it.

5. Analytical Reasoning: A broad knowledge base in geology and related disciplines such as chemistry, physics, biology and mathematics needed to provide insight into these Earth processes

6. Research – Related Skills: Develop a research design, which has an appropriate problem related to earth sciences but may incorporate some scientific methods, ability to plan and write a research paper.

7. Self and Time Management: Time management skills are developed through interaction with the assessment process for submission of continuous assessment material.

8. Leadership and Team Work: Ability to contribute effectively to team objectives and interact productively with others both in project-related settings and in meetings.

9. Scientific Reasoning: Develop a systematic understanding of both core areas and advanced topics in the study of the Earth and view the Earth from new and challenging perspectives of time, space, process and pattern.

10. Digital Literacy: Ability of advanced Word skills and advanced GIS, statistics, databases, spreadsheets, digital drawing through online workbooks and workshops

11. Moral and ethical values: The degree to which every student engages with these themes will vary but it is important that all think especially about ethical issues.

12. Life – long Learning: Ability to blend academic and practical skills and to transfer such skills to other domains of one's life and work.

Program Educational Objectives (PEOs)

1. **Creative, innovative educators and learning facilitators, who master geological Science, have the ability to use information technology to keep up with developments in geological science.**

2. **Reviewers of geological problems, both experimentally and/or literature studies and publish the results in scientific forums and journals.**

3. **Examiner of problems related to the earth sector (extraction, mitigation, and conservation) factual and applicable, providing solutions to these earth problems conceptually.**

4. **Planning and implementing staff in the exploration-production/extraction industry, and mitigation and conservation of geological resources.**

5. **Entrepreneurs whose business fields are related to commodities or equipment in the extraction, mitigation, and conservation of geological resources.**

6. **Staff to heads of agencies related to regulation, supervision, and policy makers in the extraction, mitigation and conservation of geological resources.**

Program Educational Outcomes

1. **To develop an in-depth knowledge and skills in qualitative and quantitative research methods through laboratory, field and web modes of learning.**

2. **Recognize the need for sustainable use of earth resources, and value environmental, indigenous and other community perspective on geological activities.**

3. **Apply geological knowledge and critical thinking skills to identify a problem and to describe a strategy for handling.**

4. **Synthesize geological data on arrange of spatial and temporal scales to make interpretations that allow for scientific uncertainty.**

5. **Work effectively and professionally in multidisciplinary teams as a member and a leader and be able to manage and analyze complex ethical issues.**

Program Specific Outcomes (PSOs)

1. **Learn the essential properties of Earth's components, including its core, mantle, asthenosphere, lithosphere, atmosphere, hydrosphere, and biosphere and also demonstrate mastery of the conceptual framework for understanding earth system processes and the development of earth's features overtime.**

2. **Acquiring geologic data in the field, laboratory, satellites and big data from data banks, analyzing and interpreting the data through application of scientific method.**

3. **Capable of applying advanced and current concepts and methods of the geosciences to formulate and solve complex geological problems.**

4. **Students are capable of understanding the impact of a geo-engineering solution in global and societal context.**

5. **Apply knowledge and techniques from allied fields, including mathematics, chemistry, physics, biology, geoengineering, and computing, to solve geological constraints in societal context.**

SRI VENKATESWARA UNIVERSITY: : TIRUPATI
SVU COLLEGE OF SCIENCES
MASTER OF SCIENCE
DEPARTMENT OF GEOLOGY
P.G. DEGREE PROGRAMME (CBCS) REGULATIONS – 2016
AMENDED AS PER NEP – 2020

SEMESTER – I

S.No.	Components of Study	Title of the Course	Title of the Paper	Credit Hrs / week	No. Of Credits	IA Marks	Sem End Exam Marks	Total
1	**Core**	GEO.101	Crystallography and Mineralogy	6	4	20	80	100
2		GEO.102	Igneous Petrology	6	4	20	80	100
3	**Compulsory Foundation**	GEO.103a	Structural Geology	6	4	20	80	100
		GEO.103b	Fundamentals of Geophysics	6	4	20	80	100
		GEO.103c	Micropalaeontology & Oceanography	6	4	20	80	100
4	**Elective Foundation**	GEO.104a	Geomorphology	6	4	20	80	100
		GEO.104b	Meteorology & Climate Change	6	4	20	80	100
		GEO.104c	Energy Resources	6	4	20	80	100

5.	**Practical - I**	GEO.105P	Crystallography and Mineralogy & Structural Geology and Geotectonics/ Fundamentals of Geophysics/ Micropalaeontology & Oceanography	6	3	15	60	75
6	**Practical - II**	GEO.106P	Igneous Petrology & Geomorphology/ Meteorology & Climate Change/ Energy Resources	6	3	15	60	75
7	**Practical - III**	GEO.107P	Geological Field Survey and Training Programme	6	2	10	40	50
	Total			42	24	120	480	600
8	**Audit Course**	Human Values and Professional Ethics - I		0	0	100	0	0

Note:

1) ***Students have to choose one paper each from Compulsory Foundation and Elective Foundation.***

2) ***MOOC online courses will be available in the SWAYAM and SWAYAM PRABHA MHRD web portal. Interested students may register for MOOC with the approval of the DDC but it will be considered for the award of the grade as open elective only giving extra credits.***

SEMESTER – II

S.No.	Components of Study	Title of the Course	Title of the Paper	Credit Hrs / week	No. Of Credits	IA Marks	Sem End Exam Marks	Total
1	**Core**	GEO.201	Sedimentary Petrology	6	4	20	80	100
2		GEO.202	Stratigraphy and Palaeontology	6	4	20	80	100
3	**Compulsory Foundation**	GEO.203a	Geochemistry and Isotope Geology	6	4	20	80	100
		GEO.203b	Marine Geology	6	4	20	80	100
		GEO.203c	Computer Applications and Geostatistics	6	4	20	80	100
4	**Elective Foundation**	GEO.204a	Remote sensing and GIS	6	4	20	80	100
		GEO.204b	Environmental Geology	6	4	20	80	100
		GEO.204c	Gemology	6	4	20	80	100
5.	**Practical - I**	GEO.205P	Sedimentary Petrology & Geochemistry and Isotope Geology/ Marine Geology/ Computer	6	3	15	60	75

			Applications and Geostatistics					
6	**Practical - II**	GEO.206P	Stratigraphy and Palaeontology & Remote sensing and GIS/ Environmental Geology/ Gemology	6	3	15	60	75
7	**Practical - III**	GEO.207P	Geological Field Survey and Training Programme	6	2	10	40	50
	Total			42	24	120	480	600
8	**Audit Course**	Human Values and Professional Ethics - II		0	0	100	0	0

Note:

1) ***Students have to choose one paper each from Compulsory Foundation and Elective Foundation.***

1) ***MOOC online courses will be available in the SWAYAM and SWAYAM PRABHA MHRD web portal. Interested students may register for MOOC with the approval of the DDC but it will be considered for the award of the grade as open elective only giving extra credits.***

SEMESTER - III

S.No.	Components of Study	Title of the Course	Title of the Paper	Credit Hrs / week	No. Of Credits	IA Marks	Sem End Exam Marks	Total
1	**Core**	GEO.301	Metamorphic Petrology	6	4	20	80	100
2		GEO.302	Economic Geology and Mineral Economics	6	4	20	80	100
3	**Generic Elective**	GEO.303a	Watershed Management	6	4	20	80	100
		GEO.303b	Photogrammetry					
		GEO.303c	Dimensional stones and Construction materials					
4	**Practical - I**	GEO.304P	Metamorphic Petrology, Economic Geology and Mineral Economics & Watershed Management / Photogrammetry / Dimensional stones and Construction materials	6	2	10	40	50
5	**Skill Oriented**	GEO.305	Surveying and Field Geology	6	2	10	40	50

	Course							
6	**Practical - II**	GEO.306P	Surveying and Field Geology	6	2	10	40	50
7	**Practical - III**	GEO.307P	Geological Field Survey and Training Programme	6	2	10	40	50
8	**Open Elective**	GEO.308a	Earth System Processes	6	4	20	80	100
		GEO.308b	Medical Geology					
Total				42	24	120	480	600

Note:

1) **Students have to Choose One Paper under Generic Elective.**

SEMESTER – IV

S.No.	Components of Study	Title of the Course	Title of the Paper	Credit Hrs / week	No. Of Credits	IA Marks	Sem End Exam Marks	Total
1	**Core**	GEO.401	Hydrogeology and Engineering Geology	6	4	20	80	100
2		GEO.402	Mineral Exploration and Ore Beneficiation	6	4	20	80	100
3	**Generic Elective**	GEO.403a	Mining Geology	6	4	20	80	100
		GEO.403b	Digital Image Processing					
		GEO.403c	Water Resources Management					
4	**Practical - I**	GEO.404P	Hydrogeology and Engineering Geology, Mineral Exploration and Ore Beneficiation & Mining Geology / Digital Image Processing / Water Resources Management	6	2	10	40	50
5	**Multi Disciplinary Course / Project Work**	GEO.405	Environmental Impact Assessment and Management/**Project Work**	6	4	20	80	100
6	**Practical - II**	GEO.406P	Geological Field Survey and Training Programme	6	2	10	40	50

7	**Open Elective**	GEO.407a	Fuel Geology	6	4	20	80	100
		GEO.407b	Natural hazards and Disaster Management					
	Total			42	24	120	480	600

Note:

1) **Students have to Choose One Paper under Generic Elective.**

2) **The project work shall be evaluated at the end of the IV semester with 80 marks for the report and 20 marks for the Viva-Voce with a maximum of 100 marks.**

I SEMESTER

CORE: GEO.101

CRYSTALLOGRAPHY AND MINERALOGY

Course Objectives:

1. To give students the description of elements of crystallography, crystal structures, symmetry and symmetry functions of different crystal systems and respective minerals.
2. To identify the mineralogical composition of geological materials in order to help to reveal their origin and evolution.
3. Describe the concepts of optical phenomena in thin sections of minerals.
4. Aims to provide knowledge on the structural, chemical identification of the common rock forming minerals and demonstrative how minerals make up Igneous and Metamorphic rocks.

UNIT – I:

Elements of crystallography – Derivation of the 32 crystal classes - Hermann – Maugin symbols -Twinning in crystals – X-ray crystallography.

UNIT – II:

General principles of optics: Refringence – Birefringence, pleochroism, Extinction and measurements of extinction angles, Optical ellipsoids (a) Fresnel's ellipsoid and (b) Fletchers indicatrix, optic axial angle and optic sign, Interference figures – Uniaxial and Biaxial figures, and optic anomalies.

UNIT – III:

Structure of silicates - Isomorphism and Polymorphism - Structure, Chemistry, physical and optical characters and paragenesis of the following mineral groups: Quartz, Feldspars, Feldspathoids, Aluminium silicates, Garnet, Epidote, Olivine, Pyroxene, Amphibole, and Mica.

UNIT – IV:

Structure, chemistry, physical and optical characters and paragenesis of the following Ore minerals: Iron, Aluminium, Copper, lead, and Zinc - Study of the following minerals: Beryl, Apatite, Sphene, Tourmaline, Talc and Spinel.

Course Outcomes

1. Students will be able to describe crystal structures, crystal symmetry and twinning
2. Students will learn the use of X-ray crystallography to determine the arrangement Atoms in a crystal.
3. Students will be able to identify the mineralogical composition of geological materials by studying some of the optical properties and techniques in order to reveal their origin and evolution.
4. Students will get thorough knowledge about the physical chemical and optical Characteristics of minerals could lead to the discovery of new uses for Earth's mineral resources.

Textbooks/Reference Books:

1. Paul F. Kerr, 1959: Optical Mineralogy; McGraw-Hill Inc., U.S.
2. A.N Winchell, 2011: Elements of Optical Mineralogy: An Introduction to Microscopic Petrography, Nabu Press.
3. F.C. Phillips, 2011: An Introduction to Crystallography; Read Books Publ.
4. F.D. Bloss, 1961: An Introduction to the methods of Optical Crystallography; Harcourt School.
5. R.C. Emmons, 1959: The Universal stage; Geological Society of America.
6. W.E. Ford, 1932: Dana's Text Book of Mineralogy; CBS Publishers.
7. Keith Frye, 1974: Modern Mineralogy; Prentice-Hall Inc.
8. W.A. Deer, R.A. Howie, J. Zussman, 2013: An Introduction to Rock-forming minerals, Mineralogical Society of Great Britain & Ireland.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	L								
CO2	M	L	M	L								
CO3	M	L	M	L								
CO4	H	L	H	M								

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised syllabus w.e.f. 2021 – 2022 for campus students*)

M.Sc. DEGREE EXAMINATION – 2022

FIRST SEMESTER

SUBJECT: GEOLOGY

PAPER I - GEO.101: CRYSTALLOGRAPHY AND MINEROLOGY

Time: 3hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Twinning in crystals.
2. Symmetrical Elements.
3. Optical Anomalies.
4. Birefringence.
5. Chain Silicates.
6. Polymorphism.
7. Petrogenesis of Iron
8. Explain physical properties of Tourmaline

SECTION – B

Answer ALL questions. All Questions carry equal marks ***4 X 15 = 60 M***

9. a) Derivation of 32 crystal classes

(or)

b) What is twinning in crystals? Explain types of twinning in crystal systems.

10. a) Describe and briefly explain uniaxial and biaxial figures.

(or)

b) Briefly explain Fresnel's ellipsoid with neat sketch.

11. a) Describe briefly the silicate structures with neat sketches.

(or)

b) Physical and optical properties of pyroxene Group.

12. a) Briefly explain the physical, chemical characters and petrogenesis of the Lead and Zinc ore minerals.

(or)

b) Briefly explain the physical, chemical characters and petrogenesis of the Copper ore minerals.

CORE: GEO.102

IGNEOUS PETROLOGY

Course Objectives

1. Knowledge on origin, physical and chemical characteristics and types of magma.
2. To impart knowledge on igneous processes, formation, structures, textures and classification of Igneous rocks – historic perspective and the IUGS system.
3. To understand the Bowen's reaction series and its application to petrogenesis of Igneous rocks by different magmatic processes.
4. To understand the phase equilibrium and crystallization of Uni, Binary and Tertiary systems.
5. To understand the physical and chemical processes that produce the different Igneous rocks types and their petrogenesis and distribution in the earth's crust and mantle.

UNIT – I

Introduction to Magmas - Origin, characteristics and types of magma – Physical Properties of Magma – Bowen's Reaction Principle – Magmatic differentiation: Partial Melting, Fractional crystallization, Volatile transport, Liquid immiscibility, Magma mixing and Assimilation.

UNIT – II

Introduction to Igneous Petrology – Formation of Igneous rocks - Structures and Textures of Igneous rocks - Classification of Igneous rocks: Mode and Norm, CIPW Classification, IUGS system, The Irvine – Baragar classification.

UNIT – III

Gibbs Phase Rule – Lever Rule - Phase Equilibria in Igneous Systems; Phase Rule to the One (Uni) Component Systems – Two (Bi) Component Systems; Binary System with

complete Solid Solution, Binary Eutectic System, Binary Peritectic Systems, The Alkali Feldspar System – Three (Tri) Component Systems; Di-Ab-An, Di-Fo-Si, Di-Fo-An, and Fo-An-Si.

UNIT – IV

Petrogenetic Significance of Igneous textures - Petrography and Petrogenesis of major Igneous rock types with examples of Ultramafic, Komatite, Basalt, Anorthosite, Layered intrusions, Granites, Alkaline rocks, Carbonatites, Lamprophyres, Ultramafic related rocks, Pegmatites and Kimberlites.

Course Outcomes

1. Acquire knowledge on the evolution of magma by different processes takes place from origin to emplacement with respect to different tectonic settings.
2. Explain Igneous processes, formation, structures, classification and significance of texture in explaining rock history.
3. Obtain knowledge on the crystallizing phase equilibrium of multi component magma system.
4. Identify different Igneous rocks both in hand specimens and thin sections in terms of their petrogenesis by studying the petrographic characteristics.

Textbooks/Reference Books:

1. Carmichael, Ian S. E, Turner, Francis J and Verhoogen, John, 1974: Igneous petrology, McGraw-Hill, New York.
2. John, D. Winter, 2001: An Introduction to Igneous and Metamorphic Petrology, Prentice Hall Inc.
3. Ronald, D. Frost and Carol, D. Frost, 2014: Essentials of Igneous and Metamorphic Petrology, Cambridge University Press.
4. Myron, G. Best, 2003: Igneous and metamorphic petrology, 2nd edition, Blackwell Publishing Company.
5. Hughes, C.J., 1982: Igneous petrology, Elsevier Science Publishing Company.
6. Chatterjee, S.C., 1974: Petrography of the igneous and metamorphic rocks of India, McMillan Co. Of India, Madras.
7. D.W. Hyndman, 1986 – Petrology of Igneous and Metamorphic rocks, 2nd Edition, McGraw-Hill Co., New York.
8. Francis, J. Turner and Verhoogen, 2004: Igneous and metamorphic Petrology, CBS Publishers.
9. Philpotts A.R. and J. Jay Ague, 2009: Principles of igneous and metamorphic petrology, 2nd edition, Cambridge University Press.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	L	M							
CO2	M	L	M	L	M							
CO3	M	L	M	L	M							
CO4	H	L	H	M	M							

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
FIRST SEMESTER
SUBJECT: GEOLOGY
PAPER II – GEO.102: IGNEOUS PETROLOGY

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Bowen's Reaction Principles
2. Fractional Crystallization
3. Columnar Joints
4. Irvine – Baragar Classification
5. Gibbs Phase Rule
6. Lever Rule
7. Komatite
8. Kimberlites

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. a) Describe the Origin, characteristics and types of magma

   OR

   b) Explain the Magmatic differentiation processes

10. a) Describe briefly the Igneous rock classifications

    OR

b) Describe the textures of Igneous rocks with neat sketches

11. a) Describe the application of phase rule to the Unicomponent system

OR

b) Explain the phase equilibrium in the Di-Fo-Si system.

12. a) Give a note on Petrogenetic Significance of Igneous textures

OR

b) Explain the petrography and petrogenesis of Basalt

COMPULSORY FOUNDATION: GEO.103a

STRUCTURAL GEOLOGY

Course Objectives

1. To understand how earth's rocks deform at different levels of the lithosphere and develop basic appreciation of rock deformation at different conditions and scales to understand the difference between brittle and ductile deformation regimes.
2. To study the diverse and types of structures in the field to uncover information about the history of deformation (strain) in the rocks to understand the stress field, with emphasis on the regional geology.
3. To understand the tectonic aspects and characteristic features of plutons and to understand the origin of cleavage, schistosity, lineation and their relation to major structures.
4. To understand the Shear zones and their characteristics and textural features typical of Shear zones

UNIT - I

Concept of Stress and Strain: Analyses of Stress and Stress ellipsoid; Analyses of Strain and Strain ellipsoid - Types of Deformation - Mechanics of Plastic Deformation. – Factors controlling behaviour of Materials – Failure by Rupture; Experimental data, Relation of Rupture to Stress, Relation of Rupture to Strain.

UNIT – II

Description of Folds – Nomenclature of Folds – Fold Systems – Recognition of Folds – Mechanics of Folding – Description and Classification of Faults; Criteria for recognition of Faults; Mechanics of Faulting - Normal Faults - Thrust Faults – Strike-Slip Faults – Causes of Folding and Faulting.

UNIT – III

Geometric and Genetic classification of Joints - Unconformities – Salt Domes – Tectonic aspects of Plutons - Emplacement of Large Plutons – Introduction to Cleavage and Schistosity; Terminology for Cleavage and Schistosity; Origin of Cleavage; Relation of

Cleavage and Schistosity to Major Structures – Nature of Lineation; Relation of Lineation to Major Structures and Origin.

UNIT – IV

Shear Zones – General Characteristics; Geometries; Types of Shear Zones; Mylonites and Types of Mylonites; Strain in Shear Zones; Crystallographic Preferred Fabrics; Foliation Patterns; Mica Fish; Rotation of Inclusions; Pressure Shadows and Types of Pressure Shadows; Geometry of Fibres; Determining Sense of Shear from Pressure Shadows and Fibres; Porphyroclasts and Porphyroblasts.

Course Outcomes:

1. Able to demonstrate a basic understanding of stress, strain, rheology of earth's lithosphere and comprehend how to describe and classify brittle and ductile structures.
2. Able to describe, identify and analyze the folds, faults and joints and their effects on outcrop pattern.
3. Measure, plot and interpret structural field data and can relate these to geological Maps and knows how to read geological maps and geological cross-section.
4. Obtain knowledge of shear zone characteristics and textures which are usually highly Mineralized zones.

Textbooks/Reference Books:

1. Badgley, P.C. 1965: Structural and Tectonic principles, Harper & Row; First Edition
2. Bayly B. 1992, Mechanics in Structural geology, Springer Verlag.
3. Billings M.P. 1968: Structural geology, printice-Hall of India, Private Ltd., New Delhi.
4. George, H. Davis and Stephen, J. Reynolds 1996: Structural geology of rocks and region, 2nd Edition, John Wiley & Sons, Inc. New York.
5. Blen, A Van Dar Pluijm and Stephen Marshak 1955: Earth Structure, 2nd Edition, W. W. Norton & Company.
6. Gass, I.G, Peter, J. Smith and Wilson. R.C.L., 1971: understanding the Earth, Artemis Press.
7. Hobbs, B.E, Means, W.D. and Williams P.F., 1976: An outline of Structural geology. John Wiley & Sons, Inc, New York.
8. Ramsay, J.G., 1967: Folding and fracturing of rocks. Mcgraw-Hill, New York, USA.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	L								
CO2	M	L	M	L								

CO3	M	L	M	L								
CO4	H	L	H	M								

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
FIRST SEMESTER
SUBJECT: GEOLOGY
PAPER III – GEO.103a: STRUCTURAL GEOLOGY

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Stress ellipsoid
2. Types of Deformation
3. Recumbent and Isoclinal Folds
4. Types of faults on the basis of Rake of the net slip
5. Genetic classification of Joints
6. Types of Schistocity
7. Types of Shear zones
8. Porphyroclasts

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. a) Explain in detail the Mechanics of Plastic deformation

   OR

   b) Discuss the Experimental data on Failure by Rupture

10. a) Describe the nomenclature of folds with neat sketches

    OR

    b) Explain the Criteria for recognition of faults in the field

11. a) Define Unconformity and Explain different types of Unconformities with sketches

OR

b) Discuss relation of Cleavage and Schistosity to major structures

12. a) Explain how to Determine Sense of Shear from Pressure Shadows and Fibres

OR

b) Describe the Foliation patterns in shear zones

COMPULSORY FOUNDATION: GEO.103b

FUNDAMENTALS OF GEOPHYSICS

Course Objectives

1. To understand the interrelationship between geology and geophysics
2. To know how geophysics helps to explain geodynamical features of the earth
3. To understand the general and exploration geophysics
4. Basic concepts of geophysical methods and integrated approach

UNIT –I

Gravity methods: Gravity potential and field due to different simple bodies and structures - Field procedure - Bouguer gravity anomalies, interpretations & field-cases - Applications of the gravity method.

UNIT - II

Magnetic methods: Magnetic properties of rocks, geomagnetic field, field procedure, measurement of magnetic anomalies, interpretation - Applications of the magnetic method - Seismic method: Seismic waves and wave propagation, Wave attenuation and amplitude - Seismic refraction surveying, layered earth refraction studies - Seismic reflection surveying

UNIT – III

Electrical method: Self potential, earth resistivity, different arrays, profiling & sounding techniques, interpretation & field cases - Induced polarization - Telluric & electromagnetic methods - Ground Penetrating Radar (GPR).

UNIT – IV

Subsurface geophysical methods, Borehole logging: Drilling and its effects on the formations - The measurement of strata dip, borehole inclination and diameter - The self-potential log, Resistivity logs, Radioactivity logs, The sonic log, The temperature log.

Course Outcomes

1. Get knowledge on fundamentals and relationship between geology and physics
2. Acquire knowledge on how geophysics helpful in understanding and explaining the geodynamical features of the earth.
3. Understanding the basic concepts of geophysical methods such as gravity,

magnetic, electrical and other sub-surface geophysical methods and integrated approach

Textbooks/Reference Books:

1. El Arabi H. Shendi, 2007; Introduction of Geophysics
2. Lowri,W., 2007: Fundamentals of Geophysics, Cambridge University Press.
3. Dobrin, M.B and Savit,C.H.,1988. Introduction to Geophysical Prospecting, McGraw-Hill.
4. Grant, F.S.and West,G.F.,1965. Interpretation Theory in Applied Geophysics, McGraw Hill, New York.
5. Murthy, L.Y.R. and Mishra, D.C., 1989. Interpretation of Gravity Magnetic Anomalies in Space and Frequency Domain, AEG publication, Hyderabad, India
6. Nettleton, L.L., 1976. Gravity and Magnetics in Oil Prospecting, McGraw Hill.
7. Parasnis, D.S., 1966. Mining Geophysics, Elsevier.
8. Patra, H.P. and Mallick, K., 1980. Geosounding Principles Vol. I Time layering Geoelectric Soundings. Amsterdam: Elsevier.
9. Telford, W.M., Geldart, L.P.and Sheriff, R.E.,1990.Applied Geophysics Cambridge
10. Alan, E. Mussett, Khan, M.A. 2000. Looking in to the earth: An introduction to geological geophysics, Cambridge University Press.
11. Telford, W.M., Geldart, L.P. and Sheriff, R.E., 1990. Applied geophysics. Cambridge University Press.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M									
CO2	M	L	M									
CO3	M	L	M									
CO4	H	L	H									

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
FIRST SEMESTER
SUBJECT: GEOLOGY
PAPER III - GEO 103 b: FUNDAMENTALS OF GEOPHYSICS

Time: 3 hrs **Max.Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Gravity potential
2. The law of Universal Gravitation
3. Seismic waves
4. Brief note on Geomagnetism
5. Electromagnetic Noise
6. Briefly explain the Electrical Properties
7. Define Apparent Polar Wandering
8. Self-Potential log.

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. a) Enumerate the Interpretation of Gravity Anomalies

   OR

   b) Explain the Seismic Reflection Surveying

10. a) Write a note on Bouguer gravity anomalies. Describe the applications of Gravity method

    OR

    b) Give a brief account on Magnetic Surveying Instruments

11. a) Explain in detail the Vertical Electrical Sounding (VES) Method with neat sketch

    OR

    b) Explain the Constant separation traversing interpretation method with diagram

12. a) Explain in detail the drilling and its effects on the formations

    OR

    b) Give an account on Resistivity and Radioactivity logs.

COMPULSORY FOUNDATION: GEO.103c

MICROPALAEONTOLOGY AND OCEANOGRAPHY

Course Objectives

1. To give the students basic knowledge of microfossils and their geological applications. It will provide an extended basis for more advanced studies in paleontology and stratigraphy of basin developments.
2. To gain knowledge about the (palaeo) environmental and (palaeo) climatic meaning. Skills development on methods and techniques of biostratigraphy and palaeobiology, applied to the microfossils.
3. To know the techniques in Applying Micropaleontology in hydrocarbon exploration
4. To give an overview of the science of oceanography and how it is practiced to integrate all specific concepts of oceanography into a multidisciplinary analysis of the Earth

UNIT - I

Definition and scope of the subject; Relationship of micropaleontology with ocean sciences; Modern field and laboratory techniques in the study of microfossils (collection, sampling and processing techniques, scanning electron microscopy and mass spectrometry); A brief account of the concepts and methods for the development of micropaleontological indicators useful in reconstruction of history of past, environmental changes and biostratigraphic correlation.

UNIT - II

Types of Microfossils - Calcareous Microfossils: (i) Foraminifera - Planktic foraminifera, their modern biogeography, outline of morphology, significance in Cenozoic oceanic biostratigraphy and paleoceanographic, paleoclimatic interpretations; Benthic foraminifera - their brief morphology and application in bottom water paleoceanography and paleobathymetric reconstructions; Larger foraminifera, their outline of morphology and application in Indian stratigraphy; (ii) Calcareous nannofossils - outline of morphology, modern biogeography and their application in oceanic biostratigraphy and paleoceanographic, paleoclimatic reconstructions; (iii) Ostracoda - outline of morphology and wall structure, their significance in environmental studies and oceanic biostratigraphy; (iv) Pteropoda - a brief introduction, application of pteropods in reconstruction of the Quaternary oceanography and climate; A brief introduction of calpionellids and calcareous algae.

UNIT - III

Siliceous Microfossils: Radiolaria, diatoms and silicoflagellate; outline of morphology, modern biogeography, their environmental significance and application in biostratigraphy - Phosphatic Microfossils: Conodonts; outline of morphology, paleoecology, geological significance and biological affinities; Stratigraphic significance of conodonts with special reference to India - Application of Micropaleontology in hydrocarbon exploration - Determination and correlation of paleofacies by microfossils - Interpretation of sea floor tectonism from micropalaeontological evidence.

UNIT - IV

History of development of oceanography - Sampling of modern ocean biogenic flux including sediment trap sampling - Methods of measuring properties of sea water - Temperature and salinity distribution (horizontal and vertical) in ocean waters - Dissolved gases in sea water; factors affecting the concentration of gases in sea water - Carbon dioxide equilibria, precipitation and dissolution of carbonates – Biological, chemical, physical interactions in the oceans - Oxygen minimum layer in the ocean - concept of thermohaline circulation; formation of bottom waters - water masses of the world oceans.

Course Outcomes

1. Obtain knowledge of the main systematic groups of microfossils, its distribution and (palaeo) environmental and (palaeo) climatic meaning. Skills development on methods and techniques of biostratigraphy and palaeobiology, applied to the microfossils
2. Application of knowledge and understanding: Collect, organize and analyze descriptive data of microfossils and associated sedimentary materials using adequate concepts, methodologies and techniques.
3. Acquire knowledge in applying the micropalaeontological techniques in the exploration of hydrocarbons.
4. Get knowledge on the principles involved in the generation of waves and tides and evaluate their effects on coastal processes and marine ecosystems. Summarize the major physical and chemical properties of seawater and how each affects marine life.

Textbooks/Reference Books:

1. P.K. Saraswati and M.S. Srinivasan (2016): Micropaleontology: Principles and Applications, Springer.
2. Arnold (2002): Quaternary Environmental Micropaleontology (Ed. Simon K. Haslett), Oxford
3. B.U. Haq and, A. Boersma (1998). Introduction to Marine Micropaleontology, Elsvier.
4. P.R. Pinet (1992): Oceanography: An introduction to the Planet Oceans, West Pub, Co
5. Bignot, G. (1985): Elements of Micropaleontoogy; Graham and Trotman Ltd., London.
6. David Tolmazin (1985): Elements of Dynamic Oceanography, Allen and Unwin

7. Grant Gross, M. (1977): Oceanography; A view of the Earth, Prentice Hall.
8. John Houghton (1997): Global Warming, Cambridge Univ. Press.
9. Jones, T.P. and Rowe, T.P. (1999): Fossil plants and spores, Modern Techniques, Geological Soc. of London.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	L								
CO2	M	L	M	L								
CO3	M	L	M	L								
CO4	H	L	H	M								

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022

SECOND SEMESTER

SUBJECT: GEOLOGY

PAPER III - GEO 103c: MICROPALAEONTOLOGY AND OCEANOGRAPHY

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Scope of Micropalaeontology
2. Sampling techniques of Microfossils
3. Brief morphology of Benthic Foraminifera
4. Application of Foraminifera in Paleobathymetric reconstruction.
5. Brief morphology of Radiolaria
6. Conodonts
7. Salinity in ocean waters
8. History of development of Oceanography

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. a) Give a brief note on the field and laboratory techniques in the study of microfossils

OR

b) Write a brief note on the concepts and methods useful in the environmental changes and Biostratigraphic correlation

10. a) Discuss the significance of Foraminifera in oceanic biostratigraphy interpretations.

OR

b) Give an outline of morphology and wall structure of Ostracoda and environmental significance.

11. a) Discuss the modern biogeography of Diatoms and application in biostratigraphy

OR

b) Explain the application of microfossils in hydrocarbon exploration

12. a) Brief the history of development of Oceanography and explain the methods of measuring properties of sea water.

OR

b) Explain the concept of Thermohaline and formation of bottom waters.

ELECTIVE FOUNDATION: GEO. 104a

GEOMORPHOLOGY

Course Objectives

1. To understand the processes that shape the landforms around us and how these depend on climate, tectonic regime outline.
2. To understand and apply geomorphological concepts to problems of slope instability and try to identify the factors responsible for landslide occurrences in various environments and techniques to minimize the mass wasting.
3. To know the evolution of landforms and depositional and erosional landforms of various geological agents.
4. Application of geomorphological concepts in economically important projects.

UNIT – I

Historical background of geomorphology –Fundamentals of geomorphic concepts – Geomorphic significance of weathering; soils and its profile, formation of soils – Mass wasting and its geomorphic significance; creep, solifluction, patterned ground, earth flows, mud flows, debris avalanches, landslides, subsidence forms

UNIT - II

Evolution of landforms; endogenous and exogenous forces, role of lithology, peneplanation, rejuvenation of landforms – Fluvial geomorphic cycle; streams and valleys, valley development, classification of valleys – Drainage patterns and their significance; types of drainage patterns – Morphometric analysis of the drainage basin.

UNIT – III

Depositional and erosional landforms; Fluvial, Aeolian, Glacial, and Coastal – Karst topography - Topography of Ocean floors; geomorphic features on continental shelves and slopes, submarine canyons, classification of sea valleys – Topography of Deep sea floors – Theories and origin of Barrier Reefs and Atolls.

UNIT – IV

Introduction to Paleogeomorphology; Relict land forms – Buried land forms – Exhumed land forms – Application of Geomorphology to Hydrology, Economic geology, Engineering projects and Oil Exploration.

Course Outcomes

1. Able to explain conceptual approaches in geomorphology.
2. Able to describe land forms and land forming processes in different climate zones and tectonic regimes.
3. Able to explain different theories and models for landscape evolution.
4. Obtain knowledge in recognizing and minimizing the mass wasting.
5. Able to apply geomorphological concepts in economically important projects

Textbooks/Reference Books:

1. Holmes. A, (1972): Principles of Physical Geology, The English language Book society and Nelson
2. Thornbury. W.D, (2004): Principles of Geomorphology, 2 Edition, CBS Publishers and Distributors Pvt. Ltd., New Delhi
3. Robert, S.A. and Sujanne, P.A., (2010): Geomorphology – The mechanics and chemistry of landscapes. Cambridge University Press.
4. Huggett Richard John (2007): Fundamentals of Geomorphology. 2nd Edn, Taylor & Francis.
5. Bloom. A.L., (1992): Surface of the Earth. Prentice Hall India, New Delhi.
6. Savindra Singh, (1998): Geomorphology, CBS Publishers and Distributors Pvt. Ltd., New Delhi
7. Kale, V.S., and Gupta, A. (2005): Introduction to Geomorphology. Orient Blackswan Pvt. Ltd.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	L	M							
CO2	M	L	M	L	M							
CO3	M	L	M	L	M							
CO4	H	L	H	M	M							

H: High; M: Medium; L: Low

MODAL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
FIRST SEMESTER

SUBJECT: GEOLOGY
PAPER IV – GEO.104a: GEOMORPHOLOGY

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Fundamentals of Geomorphic Concepts
2. Describe the formation of Soils
3. Explain Valley formation and Valley development
4. Role of lithology in evolution of landforms
5. Fluvial erosional land forms
6. Origin of Barrier Reefs and Atolls
7. Write a note on Buried land forms
8. Significance of Geomorphology in Economic Geology

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. a) Explain the Geomorphic significance of Weathering and describe major soil groups
   OR
   b) Describe Mass Wasting and its significance in geomorphology

10. a) Give a brief note on Fluvial Geomorphic Cycle
    OR
    b) Explain types of Drainage Patterns with neat sketches

11. a) Explain the depositional features of Glaciers with neat sketches
    OR
    b) Describe in detail the topography of Deep Sea Floors

12. a) Define Palaeogeomorphology and describe its characteristic features
    OR
    b) Give a detailed account on Application of Geomorphology to Oil Exploration

ELECTIVE FOUNDATION: GEO.104b

METEOROLOGY AND CLIMATE CHANGE

Course Objectives

1. To produce graduates who possess quantitative, scientific reasoning skills that can be applied to atmospheric problems.
2. To understand the skills for interpreting and applying atmospheric observations and knowledge of the atmosphere and its evolution.
3. Learn explain short- and medium-term weather forecasts based on sound meteorological principles.
4. To understand the physical basis of the natural greenhouse effect and the way various human activities are increasing emissions of the natural greenhouse gases.
5. To understand and explain the causes of climate change

UNIT - I

Meteorology: branches and applications - Energy spectra of sun and earth, long wave radiation, Global radiation balance, Solar energy - Atmosphere: Composition and structure of atmosphere, Layered structure of atmosphere – influences of air temperature, Surface temperature, daily cycle of temperature, annual cycle of temperature - Precipitation processes.

UNIT - II

El Nino: Introduction, upwelling. El Nino, La Nina events and consequences: Detection and prediction of El Nino - Weather forecasting: Persistence, trends, climatology, analog and numerical weather prediction methods - Forecasting surface features: Anti cyclone, cyclone, cold front and warm.

UNIT - III

Climate Change: Introduction, definition - Classification of climate; - Climatic changes through geological time, Assessing climate change, Human intervention on climate change - Greenhouse effect, greenhouse gases, Climatic change and global warming, Kyoto protocol.

UNIT - IV

Causes of climate change: Ocean circulation pattern, Changes in compositions of atmosphere, Changes in solar radiation - Impact of climate change: Rising of CO_2, impact on atmospheric circulation & weather pattern – biosphere – hydrosphere – Sea level changes, Adaptation provinces.

Course Outcomes

1. Possess scientific reasoning skills that can be applied to atmospheric problems and learn to explain short- and medium-term weather forecasts based on sound meteorological principles.
2. Explore El Nino impact and interpret weather forecasting.
3. Appraise climate change and predict it from geological records.
4. Explore impact of climate change.

Textbooks/Reference Books:

1. Alan, H. Strahler and Arthur, N.Strahler1992: Modern Physical

Geography, Fourth Edition, John Wiley & Sons. Inc
2. Alan Strahler and Arthur Strahler (2002): Physical Geography, 2nd edition, John Wiley &Sons Inc.
3. Byers (2005), Meteorology, The Encyclopedia of Britannia, 15th Ed.
4. Dorothy J. Meeritts and Andrew De(1997): Wet & Kirsten Menking, Environmental Geology – W.H. Freeman and Company, New York
5. Horace General, (1994): Meteorology, McGraw Hill., New York
6. John, M. Das (1995): The Monsoons, National Book House Trust, New Delhi (Third Edition)
7. Rev. Fr. S. Ignacimuthu (2010): Environmental Studies, MJP, Publishers,
8. Travis Hudson (2012): Living with Earth-An Introduction to Environmental Geology, PHIL earning Private Ltd.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	L	M							
CO2	M	L	M	L	M							
CO3	M	L	M	L	M							
CO4	H	L	H	M	M							

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022

FIRST SEMESTER

SUBJECT: GEOLOGY

PAPER IV - GEO 104b: METEOROLOGY AND CLIMATE CHANGE

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks 4 X 5 = 20 M

1. Define Meteorology and explain scales in Meteorology
2. Energy Spectra of Sun and Earth
3. Composition of Atmosphere
4. El Nino
5. Climatology
6. Green House effect
7. Changes in Solar Radiation
8. Sea level changes

SECTION – B

Answer ALL questions. All questions Carry equal Marks 4 x 15 = 60 M

9. a) Explain the branches of Meteorology and its applications

   OR

   b) Give a detailed note on Earth's Radiation Balance

10. a) Define El Nino and explain its events and consequences

    OR

    b) Explain the Weather Forecasting methods

11. a) Explain the effects classification of Climate

    OR

    b) Give an account on Climatic changes through geological time

12. a) Explain the causes of Climatic change

    OR

    b) Give a detailed note on impact of climate change

COMPULSORY FOUNDATION: GEO.104c

ENERGY RESOURSES

Course Objectives

1. To understand the basics of renewable energy sources like Solar, Wind, Wave, Coal, Petroleum and Atomic energy.
2. To assess the formation and distribution of reserves of Sources of Energy
3. To develop skill to characterise the energy resources based on feasibility

UNIT – I

Historical perspective of the Energy and its use – Principles of Renewable Energy – Solar Radiation and Green house Effect – Solar Water Heating - Solar Thermal Applications – Hydropower – Wind Resource and Wind Power Technology - Biomass Resources from Photosynthesis – Bioenergy Technologies - Wave Power; Tidal-current and Tidal-range Power - Types of geothermal source - Applications, Exploration, Distribution of geothermal energy - Geothermal sources in India: Future scenario

UNIT – II

Coal: Physical, chemical and optical properties of coal - Changes in properties of coal with metamorphism - Classification of coal in terms of Rank, Grade and Type – Petrology and Palynology of Coal - Conditions of formation of coal and coal seams - Industrial utilization of coal - Coal resources of India.

UNIT – III

Petroleum: Composition and physical characteristics of petroleum, fuels and other by-products of petroleum -Source rock types and examples – Origin and migration of petroleum – Entrapment of petroleum– seal rocks; structural traps; stratigraphic traps – petroleum resources and reserves – Petroliferous basins of India - exploration and exploitation of petroleum.

UNIT – IV

Concept of atomic energy - Radioactive minerals - Mode of occurrence and association of atomic minerals in nature - Geochemical abundance of radioactivity in crustal rocks, Productive geological horizons of atomic minerals in India - Nuclear raw material resources of India - Usage of nuclear energy.

Course Outcomes

1. Explain about Renewable Energy resources and importance.
2. Able to understand the types and its characteristics of energy resources
3. Analyse the potential of energy sources and their scope and limitations.

Textbooks/Reference Books:

1. John Twidell and Tony Weir, 2015: Renewable Energy Resources, Routledge.
2. Renu Dhupper, 2015: Textbook of Energy Resources and Management, CBS Publishers.
3. Andrew, L. Simon, 1975: Energy Resources, Elsevier Inc.
4. Kothari, D.P. et. al., 2011: Renewable Energy Sources and Emerging Technologies, Prentice Hall, India.
5. Navani J.P., and Sapra Sonal, 2015: Non-conventional Energy Resource; S. Chand & Company.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M									
CO2	M	L	M									
CO3	M	L	M									
CO4												

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022

FIRST SEMESTER

SUBJECT: GEOLOGY

PAPER III - GEO 104 c: ENERGEY RESOURCES

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. nergy and its Uses
2. Solar Radiation
3. Impact of metamorphism on Coal
4. Physical and Optical properties of Coal
5. Composition and Physical characteristics of Petroleum
6. Origin of Petroleum
7. Geochemistry of Uranium
8. Usage of Nuclear Energy

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. a) Give an account on Hydropower energy and technology

   OR

   b) Explain the Wind resource and Wind power technology

10. a) Explain in detail the classification of Coal

    OR

    b) Describe in detail the Coal resources of India

11. a) Explain the effects of geological agents on the properties of Reservoir rocks

    OR

    b) Give an account on Entrapment of Petroleum

12. a) Give an account on geochemical abundance of radioactivity in crustal rocks

    OR

    b) Give a detailed note on nuclear raw material resources of India

PRACTICAL SYLLABUS

PRACTICAL I – GEO.105P:

CRYSTALLOGRAPHY AND MINERALOGY AND STRUCTURAL GEOLOGY

Course Objectives:

1. To give students the description of elements of crystallography, crystal structures, symmetry and symmetry functions of different crystal systems and respective minerals.
2. To identify the rock forming minerals megascopically.
3. To identify the rock forming minerals microscopically.
4. Aims to study the optical properties of minerals.

CRYSTALLOGRAPHY AND MINERALOGY SYLLABUS

1. Crystallography: Identification of crystal models of 32 crystal classes and their crystals.
2. Megascopic Identification of rock forming minerals.
3. Microscopic Identification of rock forming minerals.
4. Determination of Optic axial angle (2V).
5. Determination of Optic orientation (Z^C).
6. Determination of extinction angle
7. Determination of Anorthite content of the Plagioclase

Course Outcomes:

1. Students will be able to describe crystal structures, crystal symmetry and twinning.
2. Able to identify and study the physical and optical properties of the different rock forming minerals both megascopically.
3. Students will get thorough knowledge about some of the optical properties and techniques of the minerals to reveal their origin and evolution.

Course Objectives:

1. Trained in determining the thickness of the ore body, and structural problems related to attitude of the rock formations.
2. Trained to determine the simple problems related to structural features of the rocks.
3. Trained to understand the structural field data and knows how to read geological maps and geological cross-sections.

STRUCTURAL GEOLOGY

8. Structural Problems concerning Dip and strike
9. Estimation of thickness – Depth of ore body.
10. Determination of Throw/Heave/Stratigraphic separation etc., related to faults.
11. Preparation and interpretation of Geological maps and sections
12. Preparation of contour diagrams.
13. Recording and plotting of field data

Course Outcomes:

1. Able to determine and solve the problems related to various structural features of the rock strata/ore body related to their thickness, strike and dip and enable the industry giving an idea how to extract the minerals economically.

2. Able to Measure, plot and interpret structural field data and can relate these to geological maps and knows how to read geological maps and geological cross-section.

PRACTICAL II – GEO.106P:

IGNEOUS PETROLOGY AND GEOMORPHOLOGY

Igneous Petrology Practical:

Course Objectives:

1. To impart knowledge on the megascopic and microscopic identification and study of various physical as well as optical properties of different types of igneous rocks.
2. To do modal analyses of important igneous rocks to determine the quantitative mineralogy, classification and petrography.
3. Gain knowledge on how to do CIPW norm classification of igneous rocks and variation diagrams to understand the evolution of igneous rocks.
4. Learn how to draw Discriminate diagrams of Pearce and Cann.

IGNEOUS PETROLOGY SYLLABUS

1. Megascopic and microscopic examination of igneous rocks.

a) Different types of granites, pegmatites, syeniles, anorthosites, dunites, peridotites, pyroxinities, basalts, andesites, rhyolites, trachytes, phonolites, kimberlites, dolerites, lamprophyres.

2. Modal analysis of some important igneous rocks and their classification.
3. Calculation of CIPW Norm
4. Variation diagrams: Harker and Niggli
5. Discriminate diagrams of Pearce and Cann.

Course Outcomes:

1. Students will be able to identify and study the various igneous rocks megascopically and microscopically to determine the physical properties, mineralogical composition, textural characteristics to classify the igneous rocks.
2. Acquire knowledge of doing modal analyses of igneous rocks to determine the quantitative mineralogy, classification, and petrography.
3. Able to do CIPW norm calculations to classify the igneous rocks and also interprete the evolution of igneous rocks by drawing variation diagrams of Harker and Niggli.
4. Able to draw discriminate diagrams to understand the tectonic affinity of volcanic igneous rocks.

Geomorphology Practical:

Course Objectives:

1. Knowledge about the study of topographic sheets and understand the physiographic features of an area and also knows contour variations and elevations of the study area.
2. Knows about preparation of drainage basin maps and morphometric analysis of the drainage basin.
3. Learn about the calculation of slope of an area and preparation of slope map.

GEOMORPHOLOGY SYLLABUS

1. Study of topographic sheets and preparation of physiographic description of an area
2. Study of soil profile of any specific area
3. Study of contour variations and elevations on toposheets.
4. Identification, classification and preparation of drainage basin map on toposheet.
5. Morphometry analysis of the drainage basin:
    a. Linear aspects
    b. Aerial aspects and
    c. Relief aspects.
6. Calculation of slope and preparation of slope map of a basin

Course Outcomes:

1. Able to study and interprete the topographic sheets and physiographic features of an area.
2. Acquire knowledge about the preparation of drainage basin maps and able to do morphometric analysis of drainage basin to assess and manage both ground and surface water resourses.
3. Able to do calculation of slope and preparation of slope map for the detailed evaluation of particular site in terms of slope stability.

PRACTICAL III – GEO.107P:

GEOLOGICAL FIELD SURVEY AND TRAINING PROGRAMME

Course Objectives:

1. Identification and petrogenetic characteristics of minerals and rocks in the field.
2. Identification of various geological structures such as folds, faults, unconformities and joint systems of different rock formations in the field.
3. Able to identify and study various soil profiles and various landforms in the field.

Syllabus:

1. Identification and petrogenetic studies of minerals and rocks in the field.

2. Study of attitude of geological formations in the field.
3. Identification of folds, faults, unconformities and joint systems of the geological formations in the field.
4. Identification and study of various landforms in the field.
5. Observation of profiles of various soils in the field.
6. Preparation of field report (draft) incorporating the above said geological characteristics in the field.

Course Outcomes:

1. Identify, observe the different minerals and rocks in the field and study the petrogenetic properties of the rocks.
2. Students will be able to identify and interprete the different structural features present in the geological formations under the different geological conditions in the field.
3. Able to study various soil profiles and various landforms in the field in order to improve and maintain the sustainability of our environment and predict and reduce the impact of contemporary earth surface processes that lead to natural hazards (such as landslides)

Audit Course:

HUMAN VALUES AND PROFESSIONAL ETHICS – I

Course Objectives

1 To provide Human Values and Ethics relating to Religion, Business, Law, Media and Environment.

2 To provide in depth knowledge about the Moral and ethical values to interpretation in their day to day activities of life.

UNIT – I

Definition and Nature of Ethics - Its relation to Religion –Politics –Business Law - Medicine and Environment - Need and Importance of Professional Ethics – Goals – Ethical Values In various Professions.

UNIT – II

Nature of Values - Good and Bad, Ends and Means, Actual and potential Values, Objective and Subjective Values - Analysis of basic moral concepts: rights, ought, duty,

obligation, justice, responsibility and freedom, Good behaviour and respect for elders, Character and Conduct.

UNIT – III

Ahimnsa (Non-Violence), Satya (Trub), Brahmacharya (Celibacy), Asteya (Non Possession) and Aparigraha (Non- stealing), Purusharthas (Cardinal virtues), Dharma (Righteousness), Artha (Wealth), Kama (Fulfillment Bodily Desire), Moksha (Liberation).

UNIT – IV

Bhagavad Gita - Niskama karma. (b) Buddhism; The Four Noble Truths – Aryaastanga marga, (c) Jainsim - mahavratas and anuvratas - Values Embedded in Various Religions, Religious Tolerance, Gandhain Ethics.

UNIT – V

Crime and Theories of punishment - (a) Reformative, Retributive and Deterrent (b) Views on manu and Yajnavalka.

Course Outcomes

1	After completion of this course the students will be able to know the importance of Ethics and Human Values in various professions.
2	Students also will get in depth knowledge and understanding of moral values and ethical code of the Indian Society. Especially embedded in various scriptures.

Textbooks/Reference Books:

1. Join, S. Mackenjie: A manual of ethics.
2. "The Ethics of Management" by Larue Tone Hosmer, Richard D Irwin Inc.
3. "Management Ethics – Integrity at work' by joseph A. Petrick and John F. Quinn, Response Books: New Delhi.
4. "Ethics in Management" by S.A. Sherlekar, Himalaya Publishing House.
5. Harold H Titus: Ethics for Today
6. Maitra. S.K. Hindu Ethics
7. William. Lilly: Introduction of Ethics
8. Sinha: A Manual of Ethics
9. Manu: Manava Dharma Sastra or the Institute of Manu: Comprising the Indian System of Duties: Religious and Civil (ed.) G.C. Haughton.
10. Susruta Samhita: Tr.Kaviraj Kunjanlal, Kunjalal Brishagratha, Chowkamba Sanskrit Series, Vol I, II & III, Varansi, Vol 100, 16-20, 21-32 and 74-77 only.
11. Charaka Samhita: Tr. Dr. Ram Karam Sarma and Vaidya Bhagavan Dash, Chowkambha Sanskrit Series office, Varanasi I, II, III Vol I PP 183-191.
12. Ethics: Theory and Contemporary Issues, Barbara Mackinnon, Wardsworth/Thomson Learning 2001.
13. Analyzing Moral Issue, Judith, A Boss, Mayfield, Publishing Company, 1999.

14. An Introduction to Applied Ethics (Ed) John H Piet and Ayodyha Prasad, Cosmo Publications.
15. Text Book for Intermediate logic, Ethics and Human Values, board of Intermediate Education & Telugu Academic Hyderabad.
16. I.C., Sharma Ethical Philosophy of India Nagin & Co, Jalandhar.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L										
CO2	M	L										
CO3	M	L										
CO4	H	L										

H: High; M: Medium; L: Low

II SEMESTER

CORE: GEO.201

SEDIMENTARY PETROLOGY

Course Objectives

1. Aim is to study ‘’Sediments’ to derive information on the depositional conditions which acted to deposit rock unit.
2. To establish the relation of the individual rock units in a basin to understand the evolution of the sedimentary sequences.
3. To learn different sedimentary environments.

UNIT- I:

History of Sedimentology – Nature and Origin of Sedimentary Rocks – Sedimentary Processes: Subaerial Weathering Processes and Products, Submarine Weathering Processes and Products – Fundamentals of Fluid Flow – Particle Transport by Fluids – Particle Transport by Sediment Gravity Flows.

UNIT – II

Sedimentary Textures: Grain Size, Particle Shape, Fabric – Sedimentary Structures: Internal Organization and Structure of Beds, Bedding Plane Markings and Structures, Deformed and Disturbed Bedding, Stromatolites and Other Biogenic Structures, Diagenetic Structures.

UNIT – III

Petrogenesis of Sedimentary Rocks: Texture, Structure and Petrography of Clastic, Volcaniclastic, Conglomerates, Breccias, Sandstone and Shale – Non-Clastic: Limestone - Sedimentary Environment and Facies: Concept - Sedimentary Facies association methods – Characteristics of Continental-Desert, Fluvial, Glacial, Lacustrine and Deltaic Environments - Marine Littoral and Barrier complex Depositional Environment.

UNIT – IV

Basin Analysis, Tectonics and Sedimentation: Mechanisms of Basin Formation, Plate tectonics and Basins, Techniques of Basin Analysis, Applications of Basin Analysis – Sedimentary Basins of India.

Course Outcomes

1 Able to identify different sedimentary rocks in both hand specimens and thin section and derive information on the depositional conditions and environments.

2 Able to study the sequence of sedimentary rock strata and describe the tectonic framework of sedimentation to understand the earth's history including palaeoclimatology and history of life.

Textbooks/Reference Books:

1. Leeder, M., 1999. Sedimentology and Sedimentary Basins From Turbulence to Tectonics. Blackwell, Oxford.
2. Lindholm, R., (1988) A practical approach to Sedimentology. Blackwell publication.
3. Gary Nicols, (2009): Sedimentology and Stratigraphy, 2nd Edn., Wiley-Blackwell.
4. Pettijohn, F.J., (1975) Sedimentary rocks. Harper and Row Publ., New Delhi
5. Selley, R.C.,(2000) Applied sedimentology, 2nd Edn., Academic Press,.
6. Sengupta, S.M, (2007), Introduction to Sedimentology, CBS Publishers & Distributors, New Delhi.
7. Sam Boggs. Jr. (2009): Petrology of Sedimentary Rocks, 2nd Edn., Cambridge University Press.
8. Sam Boggs, Jr. (2006): Principles of Sedimentology and Stratigraphy, 4th Edn., Prentice Hall, New Jersey.
9. Donald. R. Prothero, and Fred Schwab (2014): Sedimentary Geology, 3rd Edn, W.H. Freeman & Company, New York.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L										
CO2	M	L										

CO3	M	L										
CO4												

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
SECOND SEMESTER
SUBJECT: GEOLOGY
PAPER I – GEO.201: SEDIMENTARY PETROLOGY

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Brief note on Origin of Sedimentary Rocks
2. Fundamentals of Fluid Flow
3. Explain factors to determine the Shape of the grains in Sedimentary rocks
4. Ripple Marks
5. Classification of Sandstones
6. Concept of Sedimentary facies
7. Sediments of Tide dominated Shelves
8. Mechanisms of Basin formation

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. a) Describe the Sedimentary processes

OR

b) Explain the process of Particle Transport by Sediment Gravity Flows.

10. a) Explain the techniques used in Measuring the Size of the Siliciclastic grains

OR

b) Describe the classification of Sedimentary rocks based on Stratification and Bedforms.

11. a) Explain the Diagenesis of Carbonate Sedimentary rocks

OR

b) Explain in detail the Depositional Environment of Fluvial Systems

12. a) Explain the Depositional setting, Sedimentary processes and Sediment characteristics of Carbonate deposits

OR

b) Give a Brief note on Sedimentary Basins in India

CORE: GEO.202

STRATIGRAPHY AND PALAEONTOLOGY

Course Objectives

1. To make the students to understand basic principles and nomenclature of Stratigraphy methods of Stratigraphy correlation and geological time scale.
2. To know the classification, lithology, structures of major stratigraphic units with economic importance.
3. Major stratigraphic boundary problems with reference to India.
4. To acquire skills on identification, classification and documentation of palaeobiota.
5. Acquire knowledge on morphology, classification and evolutionary trends of invertebrate fossils.
6. Describe evolutionary, separation and classification of different microfossils and application of micropalaeontological techniques in hydrocarbons exploration.

UNIT-I:

Recent developments in stratigraphic classification - stratigraphic nomenclature-lithostratigraphy, biostratigraphy and chronostratigraphy - Archaean cratonic nucleii of Peninsular India (Dharwar, Singhbhum, and Aravalli cratons) - Proterozoic mobile belts (Central Indian Tectonic Zone, Aravalli-Delhi and Eastern Ghats).

UNIT- II:

Brief account of classification, lithology, structures and fossil content with economic importance of Archaean, Puranas - Phanerozoic stratigraphy of India, Tertiary, Siwaliks and

Indo-Gangetic alluvium - Concept of sequence stratigraphy - Rates of sediment accumulation - Unconformities.

UNIT- III:

Fossil record and geological time scale - Modes of preservation of fossils and concept of taphonomy; evolutionary trends in Trilobites, Gastropods, Mollusca, Cephalopoda, Brachiopoda, and Echinodermata – Micropaleontology: methods of preparation of microfossils - Morphology of microfossil groups (Foraminifera, Ostracoda) - Gondwana plant fossils and their significance.

UNIT- IV:

Applications of paleontological data in stratigraphy, paleoecology and paleoclimatology - Environmental significance of fossils - Use of microfossils in interpretation of sea floor tectonism - Application of micropaleontology in hydrocarbon exploration - Oxygen and Carbon isotope studies of microfossils and their use in paleoceanographic and paleoclimatic interpretation.

Course Outcomes

1. Students would have acquired comprehensive knowledge on principles of Stratigraphy, correlation methods classification of stratigraphic units, tectonic framework of India and Geological timescale.
2. Ability to give an account of various stratigraphic units and give stratigraphic column distribution in India, fossil content and economic importance of given geological formation.
3. Apply standard stratigraphic codes while preparing geological reports
4. Describe morphology, classification, evolutionary trends of Invertebrate fossils with geological and geographic distribution and paleoecological and paleo-enviromental relevance.
5. Ability to identify, classify and describe the morphology of the invertebrate fossils and plant fossils.
6. Application of fossils in establishing the age of the rock unit, correlation with other area, and Use of fossil in finding mineral deposits.
7. Ability to apply micropalaeotological techniques in hydrocarbon exploration.

Textbooks/Reference Books:

1. Krumbein, W.C. & solss , L.L., 1951; stratigraphy and Sedimentation; W.H.Freeman and company.
2. Carl, O. Dunbar & John Rodgers., 1957: Principles of Stratigraphy; John Wiley.
3. M.S. Krishnan, 2012: Geology of India & Burma; CBS Publishers
4. Wadia, D.N., 1953: Geology of India, ST. Martin’s Press Inc., New York.
5. Ravindra Kumar, 1985: Fundamentals of Historical Geology and stratigraphy; New Age Publishers
6. R.C. Mehdiratta: Geology of India, Pakistan, Bangladesh & Burma.

7. Purana basins of peninsular India – published by geological society of India, Bangalore.
8. Gondwana of India, Special volume Published by Gondwana society of India.
9. Geo karnataka , Centenary Volume, Published by Mysore geological department.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	L	M	M	L					
CO2	M	L	M	L	M	M	L					
CO3	M	L	M	L	M	H	M					
CO4	H	L	H	M	M	H	L					

H: High; M: Medium; L: Low

MODEL QUESTION PAPER
(Revised Syllabus w.e.f.2021-2022 for campus Students)
M.Sc., DEGREE EXAMINATION-2022
SECOND SEMESTER
SUBJECT: GEOLOGY
PAPER II – GEO.202: STRATIGRAPHY AND PALAEONTOLOGY

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Lithostratigraphy
2. Biostratigraphy
3. Economic importance of Vindhyans
4. Indo-Gangetic alluvium
5. Concept of Taphonomy
6. Mode of preservation of fossils
7. Uses of microfossils
8. Palaeoclimatic interpretation

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9 a) Give an account of recent developments in stratigraphic classification and it's nomenclature

(OR)

b) Write an essay on Archaean cratonic nuclei of Penunsular India

10 a) Brief an account of classification, lithology, structures and it's fossil content with economic importance of Cuddapahs

(OR)

b) Write an essay on phanerozoic Stratigraphy of India

11 a) Describe the morphological characters and time range of evolutionary trends in Trilobites

(OR)

b) Briefly explain the fossil record and geological time scale

12 a) Write an essay on role of foraminifera in hydrocarbon exploration

(OR)

b) Give an account of environmental significance of fossils and trace fossils

COMPULSORY FOUNDATION: GEO.203a

GEOCHEMISTRY AND ISOTOPE GEOLOGY

Course Objectives

1. This course first lays out the basic principles and techniques of modern geochemistry,.
2. Understanding processes in aqueous systems and the behaviour of trace elements in magmatic systems.
3. Introduces radiogenic and stable isotope geochemistry and illustrates their application to such diverse topics as determining geologic time, ancient climates. The focus then broadens to the formation of the solar system, the Earth, and the elements themselves.

UNIT- I:

Definition, scope and development of geochemistry - Geochemical classification of elements; Goldschmidt's classification of elements - Fractionation of elements in minerals/rocks - Geochemical principles - Geochemical cycle – Meteorites: classification, mineralogy, age and origin.

UNIT-II:

Chemical composition and characteristics of atmosphere, lithosphere, hydrosphere - Fick's laws of diffusion and activity composition relation (Roult's and Henry's law) - Application of trace elements in petrogenesis - Principles of equilibrium and Rayleigh fractionation - REE patterns, Eh and pH diagrams and mineral stability

UNIT- III:

Cosmic abundance of elements - Geochemical evolution of the earth - Distribution of major, minor and trace elements in crust and mantle - Mantle reservoirs - Geochemistry of water and water-rock interaction.

UNIT-IV:

Isotope geology: Isotopes and the periodic table - Stable Isotopes: Oxygen Isotopes, Sulfur Isotopes, Carbon Isotopes – Radioactivity and geochronology and brief outline of Rb-Sr, K-Ar and radiocarbon (C^{14}) systems.

Course outcomes

1. Understand the behaviour of elements in a geochemical context and relate this knowledge to how elements redistribute within the Earth.
2. Learn to interpret and explain interactions between Earth reservoirs.
3. Understand and interpret the major processes that form and modify the Earth's crust and mantle.
4. Use isotopes to trace geological processes and age date specific events.

Textbooks/Reference Books:

1. Manson, B. and Moore, C.B. 1991: Introduction to Geochemistry, Willey Eastern.
2. Krauskopf, K.B., 1967: Introduction to Geochemistry. McGraw Hill.
3. Faure. G., 1986: Principles of Isotope geology. John Wiley.
4. Henderson, P., 1987: Inorganic Geochemistry, Pergamon Press.
5. Arthur H. Brownlow, 1979. Geochemistry. Prentice-Hall, Inc. Englewood Cliffs, N.J

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	L								
CO2	M	L	M	L								
CO3	M	L	M	L								
CO4	H	L	H	M								

H: High; M: Medium; L: Low

MODEL QUESTION PAPER
(Revised Syllabus w.e.f.2021-2022 for campus Students)
M.Sc., DEGREE EXAMINATION-2022
SECOND SEMESTER
SUBJECT: GEOLOGY
PAPER III – GEO.203a: GEOCHEMISTRY AND ISOTOPE GEOLOGY

Time: 3 hrs **Max. Marks:80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Scope of Geochemistry
2. Geochemical principles
3. Structure of Atmosphere
4. Applications of Trace elements
5. Cosmic abundance of elements
6. Mantle reservoirs
7. Sulfur Isotopes
8. Dating method of K-Ar

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. (a) What are Meteorites? Give a detailed account on the classification and mineralogy of Meteorites.

Or

(b) Describe the Geochemical classification of elements.

10. (a) Explain the structure, composition and characteristics of atmosphere.

Or

(b) Write an essay on principles of equilibrium Rayleigh fractionations.

11. (a) Give an account of Geochemical evolution of Earth?

Or

(b) Briefly explain the distribution of major, minor and trace elements in crust and mantle.

12. (a) What are stable Isotopes? Describe the carbon and sulfur Isotopes. Add a note on its importance in the Geological studies.

Or

(b) What is radioactivity? Write a detailed note on Rb-Sr and K-Sr systems.

COMPULSORY FOUNDATION: GEO.203b

MARINE GEOLOGY

Course Objectives

1.To introduce the basic knowledge on ocean environment and processes associated in it.
2.To understand the Ocean floor tectonics
3.To develop skills to classify Coastal morphology
4.To estimate the sediments and marine deposits

UNIT – I

History of Marine Geology ,Waves, tides, currents, turbidity currents, long shore currents, rip currents, circulation - Wave Action: wave reflection, refraction and diffraction – Seiche and tsunamis – Coastal Zone Morphology (Estuaries, deltas, bays, raised beaches, features of wave erosion and deposition, tombolos, mudbanks) – Deep sea Morphology (Continental shelf, Continental slope, abyssal plains, seamounts, guyots, fracture pattern.

UNIT – II

Littoral processes – Evolution of headlands and bays – Beaches – Raised and sunken features – Evolution and classification of sea coasts and shore lines: Terrestrial, lacustrine, Shallow marine, deep sea - Siliciclastic versus carbonate sedimentation - Deep ocean silica burps - shelf-to-basin transport phenomena turbidities and gravity flows – Submarine groundwater discharge.

UNIT – III

Causes of marine regression and transgression – Description of important regressions and transgressions in the geological past – Eustasy – Origin and distribution of ocean basins –

Palaeoceanography - Ocean floor tectonics: Characteristics of Oceanic Plate – Geologic processes along Oceanic Plate boundaries – Seafloor Spreading – Evidence – lithospheric plates – Divergent plate boundaries – Trenches as convergent plate boundaries – Subduction zones– Transform fault boundaries.

UNIT – IV

Marine sedimentation – Sources, types and distribution of marine sediments – Transport of sea bottom sediment – Rate of deposition – Mineral resources: Marine phosphorite, glauconite, barium sulphate concretions, Polymetallic nodules– Gas hydrates – Beach placers: Terrigenous, Biogenic and Chemical Types – Placer Deposits - Distribution of temperature, salinity and density - Coastal zone regulation in India – India as Pioneer Investor in Seabed mining

Course Outcomes

1.Explain different types of the world oceans and their fundamental properties;
2.Classify and explain the physiographic provinces of the oceans
3.Understand the physical and other geological processes going on in the world ocean
4.Interpret the various types of data and manage the coastal environments.

Textbooks/Reference Books:

1. King, C.A.M., (1975): Introduction to Marine Geology and Geomorphology. Edward Arnold, London.
2. Radhakrishnan,V., (1996): General Geology, V.V.P. Publishers, Tuticorin.
3. Seabold, E. and Berger, W.H., (1982): The Sea Floor, Springer Verlag.
4. Kuenen, Ph. H., 1950. Marine Geology. John Wiley and Sons.
5. Shepard, F.P., (1978): Geological Oceanography, Heinmann, London.
6. Harper and Row. Kurekian, K.K., 1990: Ocean, Prentice Hall. New Jersey.
7. Svedrup, J.F., (1969): The Ocean, A Scientific American book, W.H. Freeman and company, San Francisco.
8. Kennett, J.P. (1982): Marine Geology. Prentice Hall., New Jersey.
9. Weisberg, C.P. (1979): Oceanography. McGraw Hill., New York.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	L								
CO2	M	L	M	L								
CO3	M	L	M	L								
CO4	H	L	H	M								

H: High; M: Medium; L: Low

MODEL QUESTION PAPER
(Revised Syllabus w.e.f.2021-2022 for campus Students)
M.Sc., DEGREE EXAMINATION-2022
SECOND SEMESTER
SUBJECT: GEOLOGY
PAPER III – GEO.203b: MARINE GEOLOGY

Time: 3 hrs **Max. Marks:80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Turbidity currents
2. Features of Wave erosion
3. Evolution of Beaches
4. Evolution of terrestrial shorelines
5. Sea-floor Spreading
6. Trenches
7. Types of Marine sediments
8. Gas Hydrates

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. (a) Explain the coastal zone morphology.

Or

(b) Describe the Deep sea morphology

10. (a) Explain the Evolution of Headlands and Bays

Or

(b) Describe the evolution and classification of Sea coasts.

11. (a) Explain in detail the causes of marine transgression and regression

Or

(b) Describe the origin and distribution of Ocean basins

12. (a) Write an essay on marine mineral resources

Or

(b) Explain the coastal zone regulations in India

COMPULSORY FOUNDATION: GEO.203c

COMPUTER APPLICATIONS AND GEOSTATISTICS

Course Objectives

1. To introduce the basic knowledge of Computer applications and statistics related to Geology
2. To understand various methods to store and analyze the geological data using computer applications
3. To develop skills to interpret the geological data based on statistical methods
4. To estimate the quantity of geological resources to assess the economic importance.

UNIT – I

Documentation in MS Word - Working with basic formulas and tables in MS Excel - Preparation of presentation in MS Power Point – Image manipulation and drawing

UNIT – II

Database Management Systems – open source softwares used in earth sciences

UNIT – III

Statistical applications:

Frequency Distribution, frequency curve and its characteristics – Mean, Median and Mode, Relationship between mean, median and mode - Cumulative frequency: Characteristics of cumulative frequency curve, Applications of cumulative Frequency curves.

UNIT - IV

Variance, Standard Deviation, Covariance, Coefficient of variation, Skewness and kurtosis - Binomial distribution: Characteristics, Approximating, uses. Sampling - Simple Random sampling, Restricted Random sampling – Grid sampling, Stratified sampling, Cluster sampling.

Course Outcomes

1.Comprehend the database related to field geological data
2.Prepare and Interpret graphical and pictorial data
3.Exposure to some selected softwares related to geology

Textbooks/Reference Books:

1. D. D. Sharma, 2002: Geostatistics with applications in Earth Sciences, Capital Publishing Company, New Delhi.
2. Saroj, K. Pal, 1998: Statistics for Geoscientists, Concept Publishing Company.
3. Rajaraman, V. 2014: Introduction to Computers; PHI Learning.
4. Rons Mansfield, 2001: Working in MS Office, McGraw Hill.
5. Singh, M.P.: Computer Fundamentals, Foundation Publishing House.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M									
CO2	M	L	M									
CO3	M	L	M									
CO4	H	L	H									

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022

SECOND SEMESTER

SUBJECT: GEOLOGY

PAPER III – GEO.203c: COMPUTER APPLICATIONS AND GEOSTATISTICS

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks 4 X 5 = 20 M

1. what is mail merge
2. write four short cuts in word
3. What are types of Databases
4. Name some open source software used in Geology
5. Mean
6. Median
7. Standard Deviation
8. Sampling plan

SECTION – B

Answer ALL questions. All questions Carry equal Marks 4 x 15 = 60 M

9. a) List the steps for formatting of text and tables MS Word.

   OR

   b) Explain the steps to prepare a chart in Excel using with assumed monthly rainfall data of two rain guage stations for ten years

10. a) Discuss the characteristic properties of a database

    OR

    b) Write the uses of some softwares used in geological investigations

11. a) What are the characteristics of a frequency curve? Applications of cumulative frequency curves

    OR

    b) Define a frequency distribution. Write the importance of frequency distribution

12. a) Differentiate the Skewness and Kurtosis

OR

b) Write the characteristics of grid sampling and stratified sampling

ELECTIVE FOUNDATION: GEO.204a

REMOTE SENSING AND GIS

Course Objectives

1. To learn basics of aerial remote sensing and its applications.
2. To understand the physics of electromagnetic spectrum and learn satellite remote sensing.
3. To learn characteristic features of Multi spectral remote sensing present satellites of world and application of Remote Sensing for important economically deposits.
4. To have training in GIS components models and applications.

UNIT- I:

Basic concepts and fundamentals of aerial photography - Scale of photography, Aerial cameras, factors influencing image quality, side lap and overlap, mosaicing of Aerial photographs, stereoscopy, estimation of dip and slope - Aerial photo interpretation for Geology; Techniques of interpretation; Recognition elements, Convergence of evidence for interpretation of Geology.

UNIT- II:

Basic concepts and fundamentals of Remote sensing - Electromagnetic energy and its sources - Interaction of EM radiation with atmosphere - Interaction of EM radiation with earth's surface - Atmospheric windows - different spectral regions useful for Remote sensing.

UNIT- III:

Sensors – platforms, Multispectral Remote sensing in Micro wave regions, Remote sensing in Thermal infrared regions, remote sensing satellites and their pay load characteristics - Application of remote sensing for gold, diamond and groundwater exploration.

UNIT- IV:

GIS: Hardware and software in GIS – spatial and non spatial data, Raster and vector data structures – Data conversions - Comparison of raster and vector data - Elements of GIS: Data capture, Verification and processing, data storage - Data base management systems: Types, merits and demerits - Data manipulation analysis and spatial modelling – Output format and generation.

Course Outcomes

1 Develop knowledge in basics of Remote Sensing interpretation keys and applications.
2 Formulate the relationship between EMR and satellite Remote Sensing.

3 Application for Remote Sensing for important economic deposits.
4 Operate GIS data model and demonstrate GIS techniques for various applications.
5 Apply RS and GIS techniques to analyze the various geological materials.

Text books/Reference Books:

1. Sabbins, F. F., 2007: Remote sensing – Principles and application; Waveland Print, INC.
2. Richard, G. Ray, 1960: Aerial photographs in Geologic interpretations, Report, USGS, U.S. Govt. Print. Off.
3. Bandat, H.F.V. 1962: Aerogeology; Gulf Publ. Co., Houston, Texas.
4. Victor, C. Miller. 1961: Photogeology; McGraw – Hill, New York.
5. Siegal, B.S & Gillespie, A. R. (eds), 1980: Remote sensing in Geology; John Wiley.
6. Aronoff, S., 1989: Geographical Information System: A management perspective. DDL Publication, Ottawa, 1989.
7. Burrough, P.A., 1986: Principles of Geographic Information System for Land resource assessment, Oxford University Press, New York

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	M							
CO2	M	L	M	M	M							
CO3	M	L	M	M	M							
CO4	H	L	H	H	H							

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
SECOND SEMESTER
SUBJECT: GEOLOGY
PAPER IV – GEO.204a: REMOTESENSING AND GIS

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Side lap and overlap.
2. Mosaic.
3. EMR.
4. Atmospheric Windows.
5. Remote sensing satellites.
6. Active and Passive remote sensing.
7. Raster and Vector data.
8. Elements of GIS.

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. a) Explain aerial photography, mosaicing of aerial photographs, and stereoscopy.

(OR)

b) Recognition elements of Aerial photographs with reference to geology.

10. a) Interaction of EM radiation with atmosphere.

(OR)

b) Explain briefly about the atmospheric window regions useful for remote sensing.

11. a) Give a detail account of different remote sensing platforms and their limitations .

(OR)

b) Applications of Remote sensing techniques in Ground water Exploration.

12. a) Explain various kinds of GIS data.

(OR)

b) Give an account of open source GIS softwares and their applications.

ELECTIVE FOUNDATION: 204b

ENVIRONMENTAL GEOLOGY

Course Objectives

1. To understand natural hazards and its impacts
2.To prepare students towards environmental concerns, issues, and impacts of climate change
3.To find the ways to deal with environmental problems associated mainly various types of pollutants
4. To apply the knowledge for efficient environmental decision-making, management and sustainable development.

UNIT – I

Fundamental concepts of Environmental Geology – Internal structure of the Earth – Plate tectonics and Environmental Geology – Rocks and Minerals – Ecology and Geology: Ecology for Geologists, Geology and Biodiversity, Ecological Restoration - Hazards, Disasters, and Natural Processes – Evaluating Hazards: Linkages, Disaster Prediction and Risk Assessment – The Human response to Hazards – Global Climate and Hazards – Population Increase, Land Use Change and Natural Hazards.

UNIT – II

Earthquakes: Magnitude and Intensity, Plate Boundary Earthquakes, Earthquake Processes, Earthquake Shaking, Earthquake Cycle, Earthquakes Caused by Human Activity, Earthquake Risk and Prediction – Tsunami: Effects of Tsunamis and Linkages to other Natural Hazards, Minimizing the Tsunami Hazard – Volcanic Activity: Volcanism and Volcanoes, Volcanic Features, Volcanic Hazards – Forecasting Volcanic Activity.

UNIT – III

Rivers and Flooding: Streams and Rivers, Sediments in Rivers – River Velocity, Discharge, Erosion, and Sediment Deposition, Effects of Land use Changes, Channel Patterns and Flood Plain Formation, River Flooding, Urbanization and Flooding, Nature and Extent of Flood Hazards, Adjustments to Flood Hazards – Landslides: Slope Processes and Types of Landslides, Slope Stability, Human use and Landslides, Minimizing the Landslide Hazard – Coastal Hazards: Coastal Processes, Coastal Erosion, Coastal Hazards and Engineering Structures, Human Activity and Coastal Erosion, Perception of adjustment to Coastal Hazards.

UNIT – IV

Water Pollution: An Overview of Water Pollution, Water Pollutants, Surface water Pollution and Treatment, Groundwater Pollution and Treatment, Water Quality Standards, Wastewater Treatment – Air Pollution: Historical Overview, Public Health Importance of Air Pollution, Sources and Types of Air Pollutants, Industrial Air

Pollution, Risk Assessment, Air Pollution Prevention and Control - Mineral Resources and Environment: Minerals and Human use, Geology of Mineral Resources, Environmental Impact of Mineral Development, Recycling Mineral Resources.

Course Outcomes

1. Explain different aspects of environment and local, regional and global environmental problems.
2. Classify and explain the environmental pollution and disaster control technologies
3. Prepare, interpret and implement environment projects

***Text Books/Reference Books*:**

2. Edward, A. Keller (2012): Introduction to Environmenal Geology, Pearson Printice Hall, New Jersey, USA.
3. Bennett, M.R. B., Doyle, P. (1997) Environmental Geology By. John Wiley & Sons, NewYork.
4. Rekha Ghosh and D.S., Chatterjee: Environmental Geology – Geoecosystems Protection in Mining Areas, Capital Publ. Co., New Delhi.
5. Carla W. Montgomery WCH Wm. C, (1989). Environmental Geology, Brown Publishers Dubuque, Iowa
6. Chiras, D.D, (1989) Environmental Science – A framework for decision making, Addison – Wesley Publishing Company. New York.,
7. Davis, N. et. al., (1976) Environmental Geosciences, John Wiley and sons, New York.,
8. Detwler, T.R, (1971) Man's Impact on Environment, McGraw Hill
9. Keith, L. H. (1996) Principles of Environmental Sampling. ACS Professional Reference book, Amer. Chem. Soc., Washington DC.
10. Khoshoo, T. L. (1988) Environmental Concerns and Strategies By. Ashish Publ. New Delhi.
11. Montgomery, C.W., (1989) Environmental Geology, Brown publications.,
12. Ray, P.K. and Prasad, A.K. (1995) Pollution and Health. Wiley Eastern Publ., New Delhi.
13. Strahler, A.N.,(1973) Environmental Geology, John Wiley and sons, New York.
14. Subramanian,V. (2002) A Textbook in Environmental Science, Narosa Publishing House, New Delhi
15. Valdiya, K.S. (1987) Environmental Geology – Indian Context. McGraw Hill Publ.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	M							
CO2	M	L	M	M	M							
CO3	M	L	M	M	M							
CO4	H	L	H	H	H							

H: High; M: Medium; L: Low

1. Analyses procedures for a few elements and compounds of water

MODEL QUESTION PAPER
(Revised Syllabus w.e.f.2021-2022 for campus Students)
M.Sc., DEGREE EXAMINATION-2022

SECOND SEMESTER
SUBJECT: GEOLOGY
PAPER IV – GEO.204b: ENVIRONMENTAL GEOLOGY

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Concept of Environmental geology
2. Ecology for geologists
3. Earthquake magnitude
4. Types of volcanoes
5. Effects of landuse changes due to rivers
6. Types of landslides
7. Water pollutants
8. Sources of air pollutants

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. (a) Describe in detail the relationship of Geology and Biodiversity
   Or
   (b) Write an essay on global climatic changes and hazards.

10. (a) Explain the earthquake processes, risk and mitigation measures.
   Or
   (b) What is Tsunami? Explain its prediction and hazards

11. (a) Describe the river flooding and Geomorphological changes
   Or
   (b) Write in detail about the coastal hazards

12. (a) Explain the water pollution processes and waste water treatment
   Or
   (b) Explain industrial air pollution, risk assessment and measures of control

ELECTIVE FOUNDATION: GEO.204c

GEMOLOGY

Course Objectives

1. To learn origin, classification, and gemstone resources and their stratigraphic units in india.
2. To learn and examine the nature, quality and rarity of the gemstones
3. To understand the physical and optical properties of gemstones
4. To give an idea about the gemstone testing instruments
5. To gain knowledge and to provide skills to become a successful gemmologist

UNIT – I

Introduction to Gemology – Relation to Mineralogy and Crystallography - Lithological association of Gemstones in India–What is a Gem: Precious and Semi-Precious Stones– Gem- bearing stratigraphic Units in India – Gemstone Resources of India.

UNIT – II

Criteria for recognition of gemstones – Virtues of gemstones; Colours, Optical Properties, Hardness, Fractures, Inclusions, Zoning, Brittleness, Pleochroism, Clarity, Amenability for cutting and polishing – 4 C's – Processing of gemstones – Styles of Cutting; Cabochon cut, Rose cut, Brilliant cut, zircon cut, step, trap or emerald cut and mixed cuts.

UNIT – III

Determination of various physical properties in the laboratory: Hardness, Specific gravity, Reflectivity and Reflectance, Dispersion, Lustre, Streak – Measurement of Refractive index – Colour distinction - Enhancement and treatments – enhancement methods: coloured and colourless impregnation, Dyeing, Bleaching and its identification - Methods of treatment – Laser drilling, Irradiation, Heat treatment, Surface modifications, Diffusion treatment and its identification – Composites; Types, Classification and Identification.

UNIT – IV

Uses of gemstones in jewellery, medicine, health and customs –Important Gem Species: Diamond, Corundum, Ruby, Beryl, Chrysoberyl, Cat's Eye, Alexandrite, Topaz, Spinel, Garnets, Tourmaline, Peridot, Zircon, Varieties of Quartz Group – Sphene, Feldspar, Lapis Lazuli - Synthetic Gems.

Course Outcomes

1. The course is focussed on a comprehensive learning in gemology
2. Understands the formation, classification and properties to final the grading and evaluation.

3. Knowledge in order to identify original gemstones and stimulants
4. Acquire skills which will be useful to them in gem industry

Textbooks/Reference Books:

1. Karanh, R.V. (2000): Gem and gem industry in India, Memoir 45, Geological Society of India, Banglore.
2. Anderson, B.W (1990): Gem testing (10th edition), Butterworth Scientific, London.
3. Babu, T.M., (1998):Diamonds in India, Geological society of India, Bangalore
4. Hall, C. (1994): Gemstone, Dorling Kindesley, London.
5. Deer, W.A., Houre, R. A. and zussman, S. (1992). An Introduction to rock forming minerals, ELBS, London.
6. Kerr, P.F. (1997): Optical mineralogy, 4th Ed. McGraw Hill Book & Co, New York,
7. Peter Read (1991): Gemmology 2nd Ed., Butter worth - Heinemanu Ltd. Lundu.
8. Peter Read: Gems 5th Ed. Butterworth, London
9. Richard Laddicoat (1987), Handbook of gem identification - G.I.A.
10. Santa Monica., Edward Gubelin (1986): Photo Atlas of Including Gem Stones – ABC Edition, Zurich, Gem Testing10th Ed.
11. Anderson, B.W. (1990): Gemstone Enhancement 2ndEdition, Butterworth Scientific London.
12. Nassau, K. (1994): Gemstone Enhancement; Butterworths, London.
13. Webster, Robert, 1980: Gems, 5th Ed, Butterworths, London.
14. Hall, C., Gemstones.
15. Dorling Kindersley, (1994): Read, P. Gemmology. Butterworth Heinemann,
16. O' Donoghue, M. (1999): Identification of Gemstones.

. **CO – PO Mapping:**

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	M							
CO2	M	L	M	M	M							
CO3	M	L	M	M	M							
CO4	H	L	H	H	H							

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
SECOND SEMESTER
SUBJECT: GEOLOGY
PAPER IV – GEO.204c: GEMOLOGY

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Scope of Gemology
2. What is a Gem?
3. Describe Importance of colours in Gemstones
4. Discuss the presence of inclusions in Gemstones
5. Impregnation in gemstones
6. Physical properties of gemstones
7. Polymorphs of Carbon
8. Medicinal uses of Gems

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. a) Write an essay on distribution of Gemstones in India

(OR)

b) Give an account of Gem- bearing stratigraphic Units in India

10. a) Briefly explain the Virtues of gemstones

(OR)

b) Discuss about Processing of gemstone

11. a) Write an essay on Determination of various physical properties in the laboratory

(OR)

b) Explain Enhancement methods

12. a) Write about Mineral Chemistry, structures and color variations in Diamond

(OR)

b) Uses of gemstones in jewellery, medicine, health and customs.

PRACTICAL I – GEO.205P:

SEDIMENTARY PETROLOGY & GEOCHEMISTRY AND ISOTOPE GEOLOGY

Course Objectives:

1. Megascopic identification of sedimentary rocks by studying their physical and chemical properties.
2. To impart knowledge of granulometric analysis of sediments.
3. Understand the petrographic features of clastic and non-clastic rocks.
4. Study the facies characteristics for the construction of facies succession and depositional models.
5. To impart knowledge on separation, study and analysis of heavy minerals fron the unconsolidated sediments.

SEDIMENTARY PETROLOGY SYLLABUS

1. Megascopic study of sedimentary rocks and their identification through characteristic features.
2. Granulometric analysis of unconsolidated sediments and interpreting their modes of transport, and environments of deposition.
3. Petrographic study of clastic and non-clastic rocks and interpreting textural properties, depositional environments and diagenesis.
4. Separation and analysis of heavy minerals from unconsolidated sediments and understanding provenance.
5. Construction of facies succession and depositional models with facies characteristics.

Course Outcomes:

1. Students will be able to identify the different sedimentary rocks megascopically and microscopically to understand the petrographic characteristics and interpret textural properties and determine the depositional environments and diagenetic processes.
2. Able to do granulometric analysis of unconsolidated sediments and interpret their modes of transport and environments of deposition.
3. Able to do separation and analysis of heavy minerals from the sediments and understand the Provenane.
4. By studying facies characteristics able to construct facies succession and depositional models of sedimentary formations.

GEOCHEMISTRY AND ISOTOPE GEOLOGY

Course Objectives:

1. Impart knowedge of chemical analyses of rocks and minerals by various methods.
2. To do chemical analyses of waters and representation of water analyses through

graphical methods.

3. To impart knowledge of classification of groundwater for various purposes.
4. Knowledge to estimate organic matter in soils and water.

SYLLABUS

1. Methods of the chemical analysis of rocks and minerals.
    - Spectrophotometric methods
    - Flame photometric methods
    - Titrimetric methods.
2. Chemical analysis of water samples.
3. Graphical representation of water analyses data and classification of natural waters.
4. Classification of groundwater for use in drinking, irrigation and industrial purposes.
5. Estimation of organic matter of soils and water.

Outcomes:

1. Able to do chemical analyses of minerals and rocks by using various methods such as Spectrophotometric method, Flamephotometric method and Titrimetric method.
2. Able to do chemical analyses of waters and classify the groundwater for use in drinking, irrigation and industrial purposes through graphical methods.
3. Able to estimate the organic matter in soils and waters in the laboratory.

PRACTICAL II – GEO.206P:

STRATIGRAPHY AND PALAEONTOLOGY & REMOTESENSING AND GIS

STRATIGRAPHY AND PALAEONTOLOGY

Course Objectives:

1. Study of rocks from Precambrian terrain of India.

2. Study India map to demarcate the boundaries of the Precambrian terrains and also study stratigraphic and palaeogeographic maps with reference to India..
3. Preparation of lithological characters of various stratigraphic units and learn correlation techniques.

SYLLABUS

1. Study of rocks in Hand specimens from Precambrian terrain of India.
2. Showing boundaries of the Precambrian terrains of India on map.
3. Stratigraphic and Palaeogeographic maps with special reference to India.
4. Identification of stratigraphic rocks in hand specimen.
5. Preparation of lithology and their correlation, correlation problems.
6. Morphological descriptions, systematics and illustrations of representative fossils belonging to Trilobita, Gastropoda, Cephalopoda, Brachiopoda, and Echinodermata.
7. Interpretation of palaeoclimate and palaeoenvironment based on fossil data
8. Biostratigraphic zonal assignment.
9. Identification of source reservoir and facies with fossil data.

Course Outcomes:

1. Able to describe the rock successions and their interpretation in terms of a general time scale. It provides a basis for historical geology, and its principles and methods have found application in such fields as petroleum geology.
2. Able to study India map and demarcate the boundaries of the Precambrian terrains of India.
3. Able to correlate lithological characters of various stratigraphic units to establish which sedimentary strata are the same age at distant geographical areas by means of their stratigraphic relationship..

REMOTESENSING AND GIS

Course Objectives:

1. Analyze satellite data using image processing techniques
2. Analyze aerial stereo pairs (aerial photos) using stereoscopes.
3. Perform image pre-processing and post-processing techniques
4. Classify satellite data for thematic mapping

SYLLABUS

1. Aerial photo interpretation: Scale, height and slope from the aerial photos; study of inclined and vertical photographs.
2. Interpretation of satellite images – False colour composites.
3. Visual image interpretation and extraction of thematic layers.
4. Identification of structures and lineaments.
5. Study of land use and land cover and demarcation of drainage basin.
6. Identification of Rock types and minerals.
7. GIS softwares – ARC INFO, ARC-GIS, ILWIS etc.,
8. Preparing data sets for input in GIS environment.
9. Analysis and manipulation of data in GIS.
10. Integration of spatial and temporal data.

Course Outcomes

1) Develop knowledge in basics of Remote Sensing interpretation keys and applications.
2) Formulate the relationship between EMR and satellite Remote Sensing.
3) Application for Remote Sensing for important economic deposits.
4) Operate GIS data model and demonstrate GIS techniques for various applications.
5) Apply RS and GIS techniques to analyze the various geological materials.

PRACTICAL III – GEO.207P:

GEOLOGICAL FIELD SURVEY AND TRAINING PROGRAMME

Course Objectives:

1. Study of different sedimentary rocks in the field and sedimentation processes in the sedimentary basins.
2. Study the gradation process of the sediments and identification of various stratigraphic sequences of the geological formations.
3. Knowledge of collection and study of shell organisms in the coastal areas.
4. Knowledge on the techniques of collection of water and rock samples in the field.
5. Observe the ground truth verification of thematic maps prepared based on the satellite data in the field.

Syllabus:

1. Identification of Sedimentary rock formations and study of sedimentation processes in the Sedimentary basins.
2. Study of sorting or gradation process of the sediments.
3. Identification of various stratigraphic sequences of the geological formations.
4. Identification, study and collection of shell organisms in the coastal areas.
5. Collection of water samples from various sources and also rock samples for geochemical analysis in the laboratory.

6. Ground truth verification of thematic maps prepared based on the satellite data.
7. Preparation of field report (draft) incorporating the above said geological characteristics in the field.

Course Outcomes:

1. Able to identify and study the different sedimentary rocks in the field and do gradation process of the sediments to identify the various stratigraphic sequesnces of the geological formations.
2. Able to do systematic collection of water and rock samples in the field for the geochemical analyses to classify the water and rocks.
3. Able to do ground truth verification in the field of different thematic maps prepared by using the satellite data of an area.

AUDIT COURSE:

HUMAN VALUES AND PROFESSIONAL ETHICS – II

Course Objectives

1. To provide the knowledge about the value oriented education, Medical ethics, family values and ethics and Moral code of Indian society.
2. To provide the business ethics, environmental and social ethics followed and practiced in Indian society.

UNIT – I

Value Education: Definition, Relevance to present day – Concept of Human Values: Self introspection, Self esteem - Family values: Components, Structure and responsibilities of family - Neutralization of anger – Adjustability – Threats of family life – Status of women in family and society - Caring for needy and elderly – Time allotment for sharing ideas and concerns.

UNIT – II

Medical ethics: Views of Charaka, Sushruta and Hippocrates on moral responsibility of medical practitioners - Code of ethics for medical and healthcare professionals – Euthanasia - Ethical obligation to animals - Ethical issues in relation to health care professionals and patients - Social justice in health care, human cloning, problems of abortion - Ethical issues in genetic engineering and Ethical issues raised by new biological technology or knowledge.

UNIT – III

Business ethics: Ethical stands of business, Immoral and illegal practices and their solutions - Characterizes of ethical problem in management, ethical theories, causes of unethical behaviour, ethical abuses and work ethics.

UNIT – IV

Environmental ethics: Ethical theory, Man and nature, Ecological crisis, Pest control, Pollution and waste - Climate change, Energy and population, Justice and environmental health.

UNIT – V

Social ethics: Organ trade, Human trafficking, Human rights violation and social disparities - Feminist ethics: Surrogacy/pregnancy, Ethics of media, Impact of Newspapers, Television, Movies and Internet.

Course Outcomes

1 After completion of this course the students will be able to follow and practice good behaviour with human values and moral support to their elderly family members.

2 They also aware and get knowledge about medical ethics how the doctors will behave with patients, what type of ethics should be followed by business people. They also get in through knowledge about the protection of environment social ethics like family ethics, the role of print and electronic media in prevention and protection of Human rights in Indian society.

Textbooks/Reference Books:

1. Join, S. Mackenjie: A manual of ethics.
2. "The Ethics of Management" by Larue Tone Hosmer, Richard D Irwin Inc.

3. "Management Ethics – Integrity at work' by joseph A. Petrick and John F. Quinn, Response Books: New Delhi.
4. "Ethics in Management" by S.A. Sherlekar, Himalaya Publishing House.
5. Harold, H. Titus: Ethics for Today
6. Maitra, S.K. Hindu Ethics
7. William Lilly: Introduction of Ethics
8. Sinha: A Manual of Ethics
9. Manu: Manava Dharama Sastra or the Institute of Manu: Comprising the Indian System of Duties: Religious and Civil (ed.) G.C. Haughton.
10. Susruta Samhita: Tr. Kaviraj Kunjanlal, Kunjalal Brishagratha, Chowkamba Sanskrit Series, Vol I, II & III, Varansi, Vol 100, 16-20, 21-32 and 74-77 only.
11. Charaka Samhita: Tr. Dr. Ram Karam Sarma and Vaidya Bhagavan Dash, Chowkambha Sanskrit Series office, Varanasi I, II, III Vol I PP 183-191.
12. Ethics: Theory and Contemporary Issues, Barbara Mackinnon, Wardsworth/Thomson Learning 2001.
13. Analyzing Moral Issue, Judith, A Boss, Mayfield, Publishing Company, 1999.
14. An Introduction to Applied Ethics (Ed) John H Piet and Ayodhha Prasad, Cosmo Publications.
15. Text Book for Intermediate logic, Ethics and Human Values, board of Intermediate Education & Telugu Academic Hyderabad.
16. I.C. Sharma., Ethical Philosophy of India Nagin & Co Julundhar.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	M							
CO2	M	L	M	M	M							
CO3	M	L	M	M	M							
CO4	H	L	H	H	H							

H: High; M: Medium; L: Low

III SEMESTER

CORE: GEO.301

METAMORPHIC PETROLOGY

Course Objectives

1. To propant knowledge on metamorphic processes, kinds of metamorphism, classification nomenclature, structures and textures of metamorphic rocks.
2. Metamorphic grades, zones, facies and facies series. Mineralogical phase rule and phase diagram.
3. Contact and Regional metamorphism faccies and their mineral assemblages and genesis of granulites and charnockites.

4. Metamorphic differentiation processes and origin of migamtites and study the classic regional metamorphic regions of the world and paired metamorphic belts.
5. Mineralization associated with metamorphic processes.

UNIT - I

Introduction to Metamorphism – Limits of Metamorphism - Metamorphic processes - Kinds of Metamorphism - Agents of Metamorphism. - Classification and Nomenclature of Metamorphic rocks. - Structures and Textures of Metamorphic rocks.

UNIT – II

Grades and Zones of Metamorphism – Concepts, Classification and Description of Metamorphic Facies – Mineralogical Phase Rule – Graphical Representation of Metamorphic Mineral Parageneses; Compositional Plotting, ACF, AKF, AFM phase diagrams

UNIT – III

Contact Metamorphic Facies: Hornfels, Sanidinite – Regional Metamorphic Facies: Zeolite, Greenschist, Blueschist, Amphibolite, Granulite, Ecologite – Genesis of Granulites and Charnockites - Anatexis and Origin of Migmatites - Regional Metamorphism and Paired Metamorphic Belts.

UNIT – IV

Metamorphic Reactions in Carbonate Rocks: Metamorphism of Siliceous Dolomitic Limestones, Formation of Wollastonite - Metamorphism of Pelitic Rocks –Metamorphism of Ultramafic Rocks – Metamorphism of Mafic Rocks

Course Outcomes

1. Identify metamorphic minerals in thin section and interpret met textures and able to comment on met grade and types of metamorphism.
2. Describe identify and classify metamorphic rocks in hand samples based on mineral assemblages and textures.
3. Plotting quantitative and qualitative mineral and mineral to infer the metamorphic conditions and processes study of metamorphic rocks on chemical system.
4. Establish relation between metamorphism and plate tectonics.
5. Establish metamorphic reaction principles of economically important ores and minerals associated with metamorphic processes.

Textbooks/Reference Books:

1. John, D. Winter, 2001: An Introduction to Igneous and Metamorphic Petrology, Prentice Hall Inc.
2. Ronald, D. Frost and Carol, D. Frost, 2014: Essentials of Igneous and

Metamorphic Petrology, Cambridge University Press.
3. Myron, G. Best, 2003: Igneous and metamorphic petrology, 2nd edition, Blackwell Publishing Company.
4. Chatterjee, S.C., 1974: Petrograpy of the igneous and metamorphic rocks of India, McMillan Co. Of India, Madras.
5. B. Bhaskara Rao, 1986– Metamorphic petrology, CRC Press
6. Turner F.J., 1981: Metamorphic petrology, McGraw-Hill
7. Congillen, 1982: Metamorphic Geology, London : Allen &Unwin,
8. Francis, J. Turner and Verhoogen, 2004: Igneous and metamorphic Petrology, CBS Publishers.
9. Winkler H.G.F. 1976:Petrogenesis of metamorphic rocks, Springer-Verlog, New York, Inc.
10. Philpotts, A.R. and J. Jay Ague, 2009: Principles of igneous and metamorphic petrology, 2nd edition, Cambridge University Press.
11. Bruce, W.D. Yardly, 1989 – An introduction to metamorphic petrology, Prentice Hall.
12. D.W. Hyndman, 1986 – Petrology of Igneous and Metamorphic rocks, 2nd Edition, McGraw-Hill Co., New York.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	M							
CO2	M	L	M	M	M							
CO3	M	L	M	M	M							
CO4	H	L	H	H	H							

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
THIRD SEMESTER
SUBJECT: GEOLOGY
PAPER I – GEO.301: METAMORPHIC PETROLOGY

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Limits of Metamorphism
2. Kinds of Metamorphism
3. Mineralogical Phase Rule
4. Zones of Metamorphism

5. Contact Metamorphic Facies
6. Blueschist Facies
7. Describe Formation of Wollastonite
8. Role of CO_2 in Very low-grade Metamorphism of Mafic rocks

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. a) Describe the role of Agents in Metamorphism

OR

b) Describe the textures of metamorphic rocks with neat sketches

10. a) Explain th classification and description of Metamorphic Facies.

OR

b) Describe the construction and plotting of mineral paragenesis in ACF diagram

11. a) Describe the Contact metamorphic Facies

OR

b) Explain the genesis of Granulites

12. a) Explain the Metamorphism of ultramafic MgO-SiO_2-CO_2-H_2O System.

OR

b) Explain the Metamorphism of Pelites at Very-low and Low-Grade metamorphism

CORE: GEO.302

ECONOMIC GEOLOGY AND MINERAL ECONOMICS

Course Objectives

1. Various processes of formation of economic mineral deposits
2. To understand the genetic controls exerted by physical and chemical processes on ore formation in various geological settings through geological time scale.
3. Geology, mineralogy, occurrence genesis and distribution of metalliferous deposits with case studies.
4. Geology, occurrence genesis and distribution of coal petroleum and other industrial minerals.

UNIT- I:

Processes of formation of mineral deposits – magmatic concentration, metasomatism, hydrothermal process, sedimentation, residual and mechanical concentration, oxidation, supergene enrichment, sublimation, evaporation.

UNIT- II:

Ore deposition - physical and chemical controls of ore fluids and their migration - Metallogenic epochs and provinces with special reference to India - Classification of mineral deposits; UNFC Classifications - Mineralization through geological time scale.

UNIT- III:

Geology, nature of occurrence, mineralogy, genesis and distribution of the following ore deposits with case studies of Iron, Chromite, Copper, Pb-Zn and Bauxite - Geology, nature of occurrence, genesis and distribution of Coal and Petroleum deposits - Magnesite deposits - Mica deposits - Baryte deposits - Asbestos deposits - Mineral resources of Andhra Pradesh.

UNIT – IV

Mineral economics and its concepts - Tenor, grade and specification - Strategic, critical and essential minerals – National mineral policy.

Course Outcomes

1 This course has links directly with industry and share the knowledge about a wide range of ore deposits.
2 Offers a detailed study of origin of economic mineral deposits its identification properties
and distribution in India.
3 Comprehensive knowledge in reflection light optic and ore textures.
4 Acquire practical knowledge on microchemical techniques for identification ores and estimation of ore reserves.

Textbooks/Reference Books:

1. Mead L. Jenson, Bateman, A. M. 1981: Economic Mineral deposits – John Wiley, New York.
2. Krishna Swamy, S. and Sinha, R.K. 1988: India's Mineral resources – Oxford & IBH, New Delhi.
3. K.V.G.K. Gokhale, 1973: Ore deposits of India, Thompson Press (India) Publ.
4. R.K. Sinha & N.L. Sharma. 2019: Mineral Economics, 4th Edn, Oxford & IBH, New Delhi.
5. Paul Ramdohr, 1970: Ore minerals and their intergrowth, Elsvier
6. R.L. Stanton, 1972: Ore petrology, McGraw-Hill Book Company, New York.
7. Charles, F. Park, Jr., and Roy, A. Macdiarmid, 1964: Ore deposits, W.H. Freeman & Co.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	M							
CO2	M	L	M	M	M							
CO3	M	L	M	M	M							
CO4	H	L	H	H	H							

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
THIRD SEMESTER
SUBJECT: GEOLOGY
PAPER II – GEO.302: ECONOMIC GEOLOGY AND MINERAL ECONOMICS

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Sublimation.
2. Mechanical concentration.
3. Metallogenic epochs.
4. Objectives of UNFC Classification.
5. Copper deposits of Andhra Pradesh.
6. Economic significance of Mangampeta.

7. Objectives of National Mineral Policy.

8. Tenor and Grade.

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. a) Classification of mineral deposits with reference to Bateman

(OR)

b) Briefly explain about oxidation and supergene enrichment process with a neat diagram.

10. a) Give a detailed account of UNFC Classification.

(OR)

b) Give a brief note on Mineralization through geological timescale.

11. a) Explain briefly about chromite deposits of India.

(OR)

b) Nature of occurrence, genesis and distribution of Coal and Petroleum deposits in India.

12. a) Explain the role of essential minerals in mineral economics of a country .

(OR)

b) History of National Mineral Policy and its importance.

GENERIC ELECTIVE: GEO.303a

WATERSHED MANAGEMENT

Course Objectives

1. To provide basics of watershed management
2. To apply the mitigation techniques of land erosion
3. To develop water harvesting techniques based on the terrain conditions
4. To implement the approach of people's participation in watershed management

UNIT-I

INTRODUCTION OF WATERSHED

Objectives of watershed development - Characteristics of watershed – Principles of watershed – Effects of watershed on community – Delineating the watershed – Basic data on watersheds –Need for watershed development – Watershed development programmes in India – Watershed Atlas

UNIT-II

EROSION, DEGRADATION and LAND MANAGEMENT

Types and Factors affecting erosion - Effects and control methods of erosion - Estimation of soil loss due to erosion - Universal soil loss equation –Degradation agents – Impact of the degradation of watersheds– Land use and land capability studies - Management of Agricultural, Forest, Grassland and wild land - Reclamation of saline and alkaline soils.

UNIT-III

WATER HARVESTING: Concept of Rainwater harvesting - water harvesting structures - Guidelines for construction of harvesting structures – Success stories of water harvesting structures –Role of peoples participation in construction and management of harvesting structures– Rain water harvesting from roof top

UNIT-IV

PLANNING AND MANAGEMNT

Elements of watershed management – Planning and Implementation of watershed Management activities – Multidisciplinary approach for watershed management – Impact of watershed Management.

Course Outcomes

1. Explain the importance of watershed management
2. Classify and explain the different water harvesting techniques
3. Use modern tools for land erosion control
4. Develop or improve the people's participatory approach for sustainable development and management of watersheds.

Textbooks/Reference Books:

1. Rajora, R., (1998), Integrated Watershed Management, Rewat Publications, New Delhi.
2. Tideman, E.M., (1996): Watershed Management: Guidelines for Indian Conditions, Omega Scientific Publishers, New Delhi.
3. Lal. S., (2004), Watershed Development, Management and Technology, Mangal Deep Publications.
4. Paranjape, S. et. al., (1998), Watershed Based Development: A Source Book, Bharat Gyan Vigyan Samathi, New Delhi.
5. Suresh, R., (2002), Soil and Water Conservation Engineering, Standard Publishers and Distributers, Delhi.
6. Kakade, B.K., (2002), Soil and Water Conservation Structures in Watershed Development Programs, BAIF Development Research Foundation, Pune.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	M							
CO2	M	L	M	M	M							
CO3	M	L	M	M	M							
CO4	H	L	H	H	H							

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
THIRD SEMESTER
SUBJECT: GEOLOGY
PAPER III – GEO.303a: WATERSHED MANAGEMENT

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Four objectives of Watershed management
2. Principle of watershed
3. Types of erosion
4. Control methods of erosion
5. Advantages of Rainwater harvesting structures
6. Types of harvesting structures
7. Elements of Watershed management
8. Impact of watershed management

SECTION – B

Answer ALL questions. All questions Carry equal Marks *4 x 15 = 60 M*

9. a) Discuss the Characteristics of watershed management

OR

b) Explain the importance of watershed management

10. a) What is a soil loss equation and discuss in detail

OR

b) List the degradation agents of watersheds.

11. a) Write the selection criteria of check dams with neat sketch

OR

b) Discuss the role of harvesting structures in groundwater resources

12. a) Discuss the significance of planning and implementation of watershed management

OR

b) Write the multidisciplinary approach of watershed management

GENERIC ELECTIVE: GEO.303b

PHOTOGRAMMETRY

Course Objectives

1. To provide basics of photogrammetry and its application in geological surveying
2. To apply the techniques of photo interpretation
3. To perform basic computations of distance and heights of the objects
4. To implement the GPS based survey approach

UNIT – I

Basic concept of Photogrammetry – Principle – Types of photographs – Geometric elements of aerial photographs– Scale –Planning & Execution of Photographic Flights– Aerial mosaics -Stereoscopy–Determination of horizontal ground length, direction and angles from photo coordinates - Relief and Tilt Displacement on vertical aerial photographs –Elements of aerial photo interpretation..

UNIT – II

Introduction to Analytical Photogrammetry: Image measurements, Control points, Collinearity condition, Coplanarity condition, Space resection by collinearity, Space intersection by collinearity, Analytical Stereo model, Analytical Interior Orientation, Analytical Relative Orientation, Analytical Absolute Orientation, Analytical Self-calibration.

UNIT – III

Principles of digital photogrammetry –Digital Terrain Model generation – Image correlation – Image matching – Digital Orthophoto generation - Image measurements, Orientation procedures, Epipolar geometry,–DEM quality assessment –Applications of Digital photogrammetry in GIS –Link between GIS and Digital Photogrammetry.

UNIT - IV

Establishing horizontal & vertical controls, Ground control surveys by GPS, Pass Points for Aerotriangulation, Sequential construction of Strip model from Independent models, Aerotriangulation by simultaneous Transformations, Bundled Adjustment by GPS control, Triangulation with Satellite images, Computational strategies for triangulation - Principles of LIDAR and its applications.

Course Outcomes

1. Explain the importance of photogrammetry and its relationship to land surveying and mapping
2. Classify and prepare maps on different scales
3. Use stereoscope to interpret the elements on the aerial photographs

Textbooks/Reference Books:

1. Wilfried Linder, 2006: Digital Photogrammetry – A Practical course, 2nd Edition, Springer.
2. Paul, R. Wolf and Bon A. Dewitt, 2000: Elements of Photogrammetry (3ed), McGraw Hill
3. Morris M. Thompson, Editor-in-Chief, 1966: Manual Photogrammetry
4. J. Chris. McGlone, Edward, M. Mikhail, James, S. Bethel, 2004: Manual of Photogrammetry, American Society for Photogrammetry and Remote Sensing, Bethesda, MaryLand, USA.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	M							
CO2	M	L	M	M	M							
CO3	M	L	M	M	M							
CO4	H	L	H	H	H							

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
THIRD SEMESTER
SUBJECT: GEOLOGY
PAPER III – GEO.303b: PHOTOGRAMMETRY

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Types of Photographs
2. Stereoscopy
3. Collinearity condition
4. Image measuremetnts
5. Image maching
6. Epipolar Geometry
7. Explain GPS
8. Pass points for Aerotriangulation

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. a) Note on basic concepts of Photogrammetry. Explain planning and Execution of Photographic flights.

OR

b) Describe in detail the elements of aerial photo interpretation.

10. a) Explain Collinearity and Coplanarity conditions in Photogrammetry

OR

b) Give a brief note on various analytical orientations

11. a) Define Digital photogrammetry. Explain the generation of Digital Orthophoto.

OR

b) Discuss the applications of Digital Photogrammetry in GIS.

12. a) Describe the Ground control surveys by GPS.

OR

b) Write an essay on principles of LIDAR and its applications.

GENERIC ELECTIVE: GEO.303c

DIMENSIONAL STONES AND CONSTRUCTION MATERIALS

Course Objectives

1. To introduce the knowledge on dimensional stones and construction materials
2. To classify dimensional stones and construction materials
3. To inquire suitability of the dimensional stones of construction materials

UNIT – I

Dimensional Stones: Criteria for selection of Dimensional Stones, Importance of Dimensional Stones in Archaeological Monuments – Dimensional Stone: Indian Scenario – Granite Industry in India – Dimensional Stones through Geological Time Scale – Granite Trade in South India.

UNIT – II

Dimensional Stone Varieties – Characteristics of Dimensional stone –Distribution of Dimensional Stones in India –Distribution of Dimensional Stones in Andhra Pradesh – Export and Import Qualities.

UNIT – III

Construction Materials: Varieties of Construction Materials – Ornamental and Construction Materials in Indian History – Distribution of Building Materials in Andhra Pradesh – Conservation of Commercial Rock Deposits/Monumental/Building Stones.

UNIT – IV

Engineering properties of rocks, Behaviour of rock on application of stresses: Stress and its type; Strain and its type Application of Strain and stress curve; Mohr's Circle and Stress Transformation.

Course Outcomes

1. Explain the distribution of dimensional stones and occurrence of construction materials
2. Classify dimensional stones and construction materials
3. Assess the suitability of various dimensional stones and construction materials

Textbooks/Reference Books:

1. Blyth, F.G.H. and Defreites, M.A., 1984: A Geology for Engineers
2. Krynine, D.P. and Judd, W.R., 1957: Principles of Engineering Geology.
3. Bell, F.G., 1999: Geological Hazards, Routledge, London.
4. Vikram, K., 1986: Directory of Dimensional Stones.
5. Raman, P.K., Mineral Resources of Andhra Pradesh.
6. Information Dossier on Regional Evaluation of Dimension Stone Granite in Andhra Pradesh, 1999: Geological Survey of India, OPAP.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	M							
CO2	M	L	M	M	M							
CO3	M	L	M	M	M							
CO4	H	L	H	H	H							

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
THIRD SEMESTER
SUBJECT: GEOLOGY
PAPER III – GEO.303c: DIMENSIONAL STONES AND CONSTRUCTION MATERIALS

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Meaning of Dimensional stones
2. Types of natural stones
3. Dimensional stones in Rayalaseema Region
4. Some examples of Dimensional stones
5. Conservation of commercial rock Deposits
6. Construction Materials
7. Stress and Strain in Rocks
8. Stress curve

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x15 = 60 M***

9. (a) Write an essay on criteria for selection of Dimensional stones.

Or

(b) Describe the importance of Dimensional stones Archaeological monuments.

10. (a) Briefly explain the various types of the Dimensional stones in Andhra Pradesh and Telangana

Or

(b) Write an essay on export and import qualities of Dimensional stones in India.

11. (a) Briefly explain the Ornamental and Construction materials in Indian History.

Or

(b) Distribution of Building Materials in Andhra Pradesh.

12. (a) Explain the Engineering Properties and Behaviour of the Rocks.

Or

(b) Write an essay on Mohr's circle and Stress Transformation.

PRACTICAL I – GEO.304P:

METAMORPHIC PETROLOGY & ECONOMIC GEOLOGY AND MINERAL ECONOMICS

METAMORPHIC PETROLOGY

Course Objectives:

1. To study physical and optical properties and determination of mineralogical compositon and textural characters.
2. Learn to arrange metamorphic rocks according to the faices of metamorphism.
3. Learn to construct and interpretation of ACF, AKF and AFM diagrams.

SYLLABUS:

1. Megascopic and microscopic examination of metamorphic rocks.
   a. Different types of schists, gneisses, amphibolites, granulites, eclogites, slates, marbles and quartzites
1. Arranging metamorphic rocks according to the facies of metamorphism.
2. Construction and interpretation of ACF diagrams.
3. Construction and interpretation of AKF and AFM diagrams.

Course Outcomes:

1. Able to determine the physical and optical properties, mineralogical compositon and textural characteristic of metamorphic rocks determining the conditions under which the rock has formed, which can give valuable insight into its geologic past.
2. Able to arrange metamorphic rocks according to their facies of metamorphism.

3. Able to construct and interpret ACF, AKF and AFM diagrams to know relative proportions of the oxides of alkalis (A), iron (F), and magnesium (M) in metamorphic rocks and to show how metamorphic mineral assemblages vary as a function of rock composition within one metamorphic facies

ECONOMIC GEOLOGY AND MINERAL ECONOMICS SYLLLABUS:

Course Objectives:

1.To provide the basics of hydrological properties of rock, aquifers, source of groundwater pollution and artificial recharge structures
2.To analyze the quality of water
3.To design the groundwater movement
4.To conduct groundwater investigations
5.To insist on the management of groundwater and methods of groundwater recharge

Syllabus:

1. Megascopic study of structures and fabrics of different Ore minerals and Industrial minerals.
2. Mineralogical and textural studies of common Ore minerals Under Ore microscope and their paragenetic significance.
3. Microchemical techniques for identification of Ores.
4. Exercises on mine sampling and determination of tenor and estimation of Ore reserves.
5. Analyze data on mineral production, use and export

Outcomes:

1). This course has links directly with industry and share the knowledge about a wide range of ore deposits.

2). Offers a detailed study of origin of economic mineral deposits its identification properties and distribution in India.

3.). Comprehensive knowledge in reflection light optic and ore textures.

4). Acquire practical knowledge on microchemical techniques for identification ores and estimation of ore reserves.

SKILL ORIENTED COURSE: GEO.305

SURVEYING AND FIELD GEOLOGY

Course Objectives

1. To provide basic knowledge on chain, compass, plane table , theodolite, other field equipment and Aerial photographs
2. To analyze the Measurement techniques, aerial photographs and equipment used in land surveying
3. To design and problem solving skills in surveying using surveying equipments and techniques.
4. To demonstrate knowledge and understanding of the geological report

UNIT- I:

Scales, Measurement of distances with the survey instruments - Chain survey: Principles, offsets, cross staff, obstacles in chaining Compass Survey - Prismatic Compass - Surveyors' compass: Traverse with chain and compass–Methods of plane tabling, the two point problems, and the three point problems.

UNIT- II

Principles of leveling, Different type of level, Classification of leveling - Measurement of angles, Heights and Distances using Theodolite - Traverse survey with the Theodolite – Principle of Total station; Measurement of Distance, Area, Height, Angles, Gradients, Traversing, Contouring using Total station - Applications of using Total Station

UNIT- III

General basics of field geology - Field equipment and Safety – Introduction to field observations at different scales – The Field Notebook - Plotting Geological features on a Base map – Recording Palaeontological Information, Structural Information, Features of Sedimentary rocks, Igneous rocks and Metamorphic rocks.

UNIT- IV

Mapping geological features on Aerial Photographs – Geological mapping with the Alidade and Plane Table – Making a geological map from Aerial photographs – Preparing Geological reports - Making a Geological Map – Recording Numerical data and and use of instruments in the field – Photography and Sampling.

Course Outcomes

1 Understand the use of different surveying instruments, field equipment, aerial photographs and their use.
2 Compute the area and earthwork for different works by using surveying instruments
3 Analyze surveying techniques, tools, survey data and geological reports
4 Prepare contour maps, geological maps and reports
5 Solve survey issues using proper survey and interpretation.
6 Use appropriate modern tools in surveying and mapping

Textbooks/Reference Books:

1. T.P. Kanetkar and S.V. Kulkarni: Surveying & Levelling, Vol. I, R Agor Books.
2. B.C. Punmiya, 2017: Surveying and Levelling, McGraw-Hill Education.
3. Robert, R. Compton, 1962: Manual of field geology, John Wiley & Sons, New York.
4. Frederick, H. Lahee, 1961: Field geology, McGraw-Hill Company, New York.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	M							
CO2	M	L	M	M	M							
CO3	M	L	M	M	M							
CO4	H	L	H	H	H							

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
THIRD SEMESTER
SUBJECT: GEOLOGY
PAPER IV – GEO.305: SURVEYING AND FIELD GEOLOGY

Time: 3 hrs **Max. Marks: 40**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks 4x 3 =12M

1. Types of scales
2. Principle of surveying
3. Classification of levelling
4. Scale in theodolite
5. Basic field kit for geologists
6. List of uses with clinometer
7. Elements of aerial photographs
8. Importance of geological report

SECTION – B

Answer ALL questions. All questions Carry equal Marks 4 x 7 = 28 M

9. a) What are the sources of errors in chain survey? What precautions would guard against them?

OR

b) Enlist the obstructions in a compass survey and explain the methods to overcome them.

10. a) How would you set up plane table at a station? Explain the various steps of setting.

OR

b) Explain in detail the temporary adjustments of a dumpy level

11. a) Write the uses of field kit for geologist. Discuss the procedure of sampling procedure and field note preparation.

OR

b) List the basic elements to be noted and measured in the field for various geological surveys.

12. a) What is a base? Discuss the structural elements useful in geological projects

OR

b) Discuss the scale of aerial photographs and their applications

PRACTICAL II – GEO.306P:

SURVEYING AND FIELD GEOLOGY

Course Objective:

Objectives

1. To provide basic knowledge on chain, compass, plane table , theodolite, other field equipment and Aerial photographs
2. To analyze the Measurement techniques, aerial photographs and equipment used in land surveying
3. To design and problem solving skills in surveying using surveying equipments and techniques.
4. To demonstrate knowledge and understanding of the geological report

Syllabus:

1. Plotting of area using Cross staff
2. Determination of area by radiation method using compass
3. Longitudinal and cross–sectioning of a road profile using levelling instrument
4. Measurement of heights and distances using theodolite
5. Determination of areas using theodolite
6. Contouring using total station
7. Identification of the rocks and their outcrop pattern in the field
8. Measurement of attitude of beds in and around engineering project site / mining area.
9. Identification of the landforms and geological information using toposheets of an engineering project site / mining area.

Course Outcomes:

1) Understand the use of different surveying instruments, field equipment, aerial photographs and their use.
2) Compute the area and earthwork for different works by using surveying instruments
3) Analyze surveying techniques, tools, survey data and geological reports
4) Prepare contour maps, geological maps and reports
5) Solve survey issues using proper survey and interpretation.
6) Use appropriate modern tools in surveying and mapping

PRACTICAL III - GEO.307P:

GEOLOGICAL FIELD SURVEY AND TRAINING PROGRAMME

Course Objective:

1. Geology is the one of the most interesting subject about mother earth which can be best studied on field.
2. Fieldwork is an important part of Geology as it provides many of the data on which our knowledge of the Earth and its evolution along with that of life through time.
3. It can be considered as the glue that binds together all of the different subdisciplines within the study of our planet.
4. Geological field work is important to understand rocks in their natural environment and their natural relationship to one another. It seeks to describe and explain the surface feature and underground structure of the lithosphere based upon observations and inferences.

Syllabus:

1. Observation of metamorphism in the geological formations.
2. Identification and study of Para and Ortho metamorphic activity in the metamorphic rocks.
3. Study of association and occurrence of economic minerals in the mining areas.
4. Identification of various Rain water Harvesting structures and their impact studies in a basin.
5. Field visit to quarry of dimensional stone mining areas to understand the mining procedures and processes.
6. Field exposure to latest equipments in the mining areas.
7. Preparation of field report (draft) incorporating the above said geological characteristics in the field.

Course Outcomes

1. Fieldwork is an important part of Geology as it provides many of the data on which our knowledge of the Earth and its evolution along with that of life through time.
2. It can be considered as the glue that binds together all of the different subdisciplines within the study of our planet.
3. Fieldwork enables students to develop their understanding of different perspectives on social, political or ecological issues, enabling them to clarify and justify their own values whilst learning to acknowledge and respect other people's values

OPEN ELECTIVE: 308a

EARTH SYSTEM PROCESSES

Course Objectives

1. To explore the fundamental interactions of the geosphere, hydrosphere, atmosphere and biosphere.
2. The unit is designed to provide a strong scientific foundation for understanding and contextualizing studies of the environment, human impacts and sustainable practice and management of resources.

UNIT – I

Introduction to various branches of Earth Sciences - Solar System: Origin of Solar system, Meteors and Meteorites - Age of the Earth –Earth Dynamics: Interior of the Earth, Composition of the Earth, Seismic waves, Plate Tectonics, Landslides, Volcanoes.

UNIT – II

Sea waves, Tides, Ocean currents - Geological work of seas and oceans - Tsunami and its causes, Warning system and mitigation.

UNIT – III

Hydrogeology: Hydrological cycle, Aquifers – Groundwater fluctuations and Groundwater composition - Glaciology: Glacier types, Different types of glaciers, Landforms formed by glacier - Rock, Mineral, Batholiths, Dyke, Sill, Folds, Faults, Joints, Unconformity.

UNIT – IV

Structure and composition of atmosphere, Atmospheric circulation, Green house effect and global warming, Carbon dioxide sequestration - Geological work of wind –Steps to maintain clean and pollution free atmosphere with governing laws, precautionary measures against disasters.

Course Outcomes

1. The interaction between the Earth's spheres, relevant processes and environmental changes.
2. Knowledge and understanding Recapitulate processes in the different spheres.
3. Describe the connections and feedback between the Earth's spheres. Explain theconnection between Earth System processes and global environmental changes.
4. A basic understanding of the Earth as an holistic system knowledge

of the main components of the Earth system and their interactions

5. The interactions between biological, chemical, and physical processes that shape and define the Earth System.

Textbooks/Reference Books:

1. Holme's Principles of Physical Geology. (1992): Chapman & Hall.
2. Emiliani, C, (1992): Planet Earth, Cosmology, Geology and the Evolution of Life and Environment, Cambridge University Press.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	M							
CO2	M	L	M	M	M							
CO3	M	L	M	M	M							
CO4	H	L	H	H	H							

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
THIRD SEMESTER
SUBJECT: GEOLOGY
PAPER V – GEO.308a: EARTH SYSTEM PROCESSES

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Meteorites
2. Seismic waves
3. Sea waves
4. Tsunami
5. Land form
6. Unconformity
7. Global warming
8. Atmosphere

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. a) Write an essay on classification and types of Meteorites

(OR)

b) Describe the theory of Plate tectonics

10. a) Explain in detail the geological work of seas

(OR)

b) Define Tsunami. Explain its causes and mitigation measures

11. a) Define a fault, write an essay on the classification of faults

(OR)

b) Define a glacier. Discuss the types and geological activities of glaciers

12. a) Write an essay on global warming and its mitigation.

(OR)

b) Write an account of the composition and structure of atmosphere

OPEN ELECTIVE: 308b

MEDICAL GEOLOGY

Course Objectives

1. To provide knowledge and skills on the interpretation of the geological impact on geographical distribution of diseases in the environment, and on human and animal health
2. To understand the basics of minerals and their influence on human health, flora and fauna.
3. To assess the occurrence of various elements and its cyclic movement through the abiotic-biotic environment

UNIT-I

General characteristics of tropical, subtropical environments - Rock weathering and soil formation - Weathering and formation of secondary minerals - Chemistry of weathering of ultra-basic rocks - Fundamental Relationship of Public Health and Geological Processes - Environmental Biology - Natural Distribution and Abundance of Elements - Anthropogenic Sources - Uptake of Elements on Chemical and Biological Perspective and its functions - Geological Impacts on Nutrition.

UNIT-II

Radon in Air and Water, Arsenic in Groundwater and the Environment - WHO and BIS Standards for drinking water - Fluoride in Natural Waters, soils, sediments, plants - Bioavailability of fluoride, Dental fluorosis, Skeletal fluorosis, Water Hardness and Health Effects, Geochemical basis for tropical endomyocardial fibrosis (EMF) - Effect of water hardness on urinary stone formation 58 (urolithiasis) - Types of stones: Calcium oxalate, Calcium phosphate, Uric acid, Magnesium ammonium phosphate stones, Cysteine.

UNIT-III

The iodine cycle in the environment - Iodine in drinking water, Iodine in food, Iodine Deficiency Disorders (IDD), Endemic cretinism, Goitrogens - The nitrogen cycle, Nitrate as fertilizers and environment, Nitrogen loading in rice fields, Nitrates from human and animal wastes, Nitrates and Methemoglobinemia, Nitrates and cancer - Bioavailability of Elements in Soil - Selenium Deficiency and Toxicity in the Environment - Natural Aerosolic Mineral Dusts and Human Health - Animals and Medical Geology - The Impact of Micronutrient Deficiencies in Agricultural Soils and Crops on the Nutritional Health of Humans.

UNIT-IV

Environmental Toxicology; Environmental Epidemiology, Environmental Medicine, Environmental Pathology, Speciation of Trace Elements - Techniques and Tools of GIS in Human Health Studies, Investigating Vector - Borne and Zoonotic Diseases with Remote Sensing and GIS - Mineralogy of Bones, Inorganic and Organic Geochemistry Techniques - Histochemical and Microprobe Analysis in Medical Geology.

Course Outcomes

1. Explain about relationship of human Health and Geological Processes.

2. Able to understand the importance of the Water quality standards and impact of micronutrient deficiencies in soils and crops on human health
3. Analyse the interaction of abundance of elements and geological effects.

Textbooks/Reference Books:

1.C.B., Dissanayake and R. Chandrajith (2009): Introduction to Medical Geology, Springer, London

2. H. Catherine, W. Skinner, Antony R. Berger (2003). Geology and Health: Closing gap, Oxford Univ. press, New York.

3. Iosif, F. Volfson, (2010): Medical Geology: Current Status and Perspectives, 2010, Russian Geological Society (ROSGEO) Publisher. Moscow.

4. K.S. Valdiya, (2004): Geology, environment, Society, University press (India), Hyderabad.

5. Lawrence K. Wang, Jiaping Paul Chen, Yung-Tse Hung, Nazih K. Shammas., (2009): Heavy Metals in the Environment, CRS Press, Taylor & Francis Group, Boca Raton, FL

6. M.M. Komatica., (2004): Medical Geology, Vol.2, Effects of geological environment on Human health, Elsevier, U.K.

7. Olle Selinus, B., Elsevier (2003): Essentials of Medical Geology (2005), Academic Press., U.K.

8. Olle Selinus, B., Finkleman, R.B., Jose, A. Centeno (2010): Medical Geology - Regional synthesis (2010), Springer, London.

9. Scott S. Olson., (1999) International Environmental Standards Handbook , CRC Press, London.CKE

10. William N. Rom., (2012). Environmental Policy and Public Health - Air Pollution, Global Climate Change, and Wilderness, by John Wiley & Sons, Inc. Published by Jossey Bass A Wiley Imprint.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	M							
CO2	M	L	M	M	M							
CO3	M	L	M	M	M							
CO4	H	L	H	H	H							

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
FOURTH SEMESTER
SUBJECT: GEOLOGY
PAPER V - GEO.308b: MEDICAL GEOLOGY

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

6. Natural distribution of elements
7. Rock weathering and soil formation
8. Skeletal fluorosis
9. Effect of water hardness on human health
10. Iodine cycle in drinking water
11. Nitrates and its health effects
12. Environmental medicine.
13. Mineralogy of bones

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

14. a) Explain the weathering processes and products. Give a note on fundamental relationship between human health and geological processes

OR

a) Write an essay on natural distribution and abundance of elements

10. a) Explain the Geochemical basis for tropical endomyocardial fibrosis (EMF)

OR

b) Discuss the WHO and BIS standards of drinking water of Radon, Arsenic and Fluoride

11. a) Explain the Iodine cycle and give a note on Iodine Deficiency Disorders

OR

b) Write an essay on Bioavailability of elements in soils.

12. a) Give a note on techniques and tools in GIS on human health studies

OR

b) Explain the Histochemical and Microprobe Analysis in Medical Geology

IV SEMESTER

CORE: GEO.401

HYDROGEOLOGY AND ENGINEERING GEOLOGY

Course Objectives

1. To provide the basics of hydrological properties of rock, aquifers, source of groundwater

pollution and artificial recharge structures

2. To analyze the quality of water
3. To design the groundwater movement
4. To conduct groundwater investigations, to insist on the management of groundwater and methods of groundwater recharge
5. Role of geologist in engineering projects geological consideration for the selection of sites for major engineering projects.

UNIT – I

Precipitation, Runoff, Infiltration, Evaporation, Transpiration- Hydrological properties of rocks- Origin, Occurrence and Vertical Distribution of Ground water – Classification of aquifers - Geological Formations as Aquifers – Springs - Darcy's Law, Cone of Depression – Hydrographs - Water Table Contour Maps - Dispersion of Groundwater Tracers - Water Quality Standards: Analyses and Interpretation.

UNIT - II

Groundwater Exploration: Surface and Subsurface Geological, and Geophysical Methods of Groundwater Exploration - Hydrogeomorphic Mapping using various Remote Sensing Techniques - Artificial Recharge of Groundwater - Conjunctive use of Surface and Ground water.

UNIT – III

Role of geologist in the engineering projects - Engineering properties of rocks - physical characters of building stones, concrete and other aggregates –Rock as a Construction material – Geological consideration for the construction of dam and Reservoir sites -Types of dams, remedial measures for failure of dams and reservoirs - Case histories of some major dams: Nagarjuna Sagar, Srisailam and Bhakranangal.

UNIT – IV

Geological considerations in the selection of tunnels.–tunnelling – remedial measures for failure of dams and reservoirs–Influence of geological conditions on foundations and design of buildings - Geological considerations for the construction of roads/ highways and bridges - seismicity in India - geological consideration for earthquake resistant structures - Problems of groundwater in engineering projects.

Course Outcomes

1. Apply the knowledge of geological formations and the hydrological properties of rocks
2. Analyze the suitability of water for domestic, irrigation and industrial purposes Conduct geological and geophysical investigations and give recommendations for drilling of borewells.
3. Explain causes of pollution of groundwater give remedial measures to the society.
4. Use modern methods and appropriate techniques to carrying out geophysical studies and artificial recharge methods

5. Students will get critical knowledge on evaluation of geological condition at the major engineering project sites.

Textbooks/Reference Books:

1. Schward and Zhang, 2003: Fundamentals of Groundwater, John Willey and Sons.
2. Todd, D.K., 2004: Ground Water Hydrology, John Wiley & Sons, New York.
3. Davies, S.N. and De-West, R.J.N., 1966: *Hydrogeology*, John Wiley & Sons, New York.
4. Raghunath, H.M., 1987: *Ground Water*, Wiley Eastern Ltd., Calcutta.
5. Driscoll, F.G., 1988: *Ground Water and Wells*, UOP, Johnson, Div. St. Paul. Min. USA.
6. Fetter, C.W., 1984: *Applied Hydrogeology*, McGraw-Hill Book Co., New York.
7. Fitts, C.R., 2013: *Groundwater Science*, Academic Press.
8. Freeze, R.A. and Cherry, J.A., 1979: *Groundwater*, Englewood Cliffs, NewJersey: Prentice-Hall.
9. Karanth, K.R., 1987: *Groundwater: Assessment, Development and Management*, Tata McGraw - Hill Pub. Co. Ltd.
10. Krynine & Judd., Principles of Engineering Geology and Geotectonics (Mc Graw Hill)
11. Parbin Singh., Engineering and General Geology
12. Blyth., Geology of Engineers (ELBS)
13. Sathya Narayanswami, B.S., Engineering Geology (Dhanpat Rai & Co.)
14. Rangwala, S.C., Engineering Materials

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	M							
CO2	M	L	M	M	M							
CO3	M	L	M	M	M							
CO4	H	L	H	H	H							

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
FOURTH SEMESTER
SUBJECT: GEOLOGY
PAPER I – GEO.401: HYDROGEOLOGY AND ENGINEERING GEOLOGY

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

10. Infiltration and Transpiration
11. Darcy's law
12. Vertical Electrical Sounding
13. Well logging
14. Physical characters of Building stones
15. Types of Dams
16. Briefly explain seismicity in India
17. Geological considerations for the construction of Bridges

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. a) Explain the hydrological properties of rocks

(OR)

b) Describe in detail the occurrence and vertical distribution of groundwater

10. a) Explain the Electrical Resistivity method of groundwater exploration

(OR)

b) Discuss the characteristic features of Conjunctive use of groundwater

11. a) Describe the engineering properties of rocks

(OR)

b) Discuss the geological considerations for the selection of site for the dam construction

12. a) Discuss the geological conditions for the foundation and design of buildings

(OR)

b) Give a detailed note on problems of groundwater in engineering projects

CORE: GEO.402

MINERAL EXPLORATION AND ORE BENEFICIATION

Course Objectives

1. Knowledge on energy resources and guides to locate ore bodies.
2. To enhance knowledge on various methods of exploration.
3. Knowledge on geophysical methods for ore reserve estimation
4. To impart knowledge on Ore beneficiation processes and techniques.

UNIT – I:

Conservation of minerals - Renewable and non-renewable resources - Guides to locate ore bodies: Physiographic, Lithologic, Mineralogical and Structural guides.

UNIT- II:

Stages of Exploration; Scope, Objectives and Methods of Prospecting - Regional Exploration: Geological, Geochemical and Geobotanical Methods - Geologic aspects of Drilling - Types of Drills - Drilling methods: Planning, Selection of Sites, Angle and Direction of Bore-holes.

UNIT – III

Methods of sampling - Weighting of samples and calculation of average grades - Mathematical and Statistical Methods - Ore Reserve Estimation - Geophysical Methods: Ground and Airborne Surveys; Gravity, Magnetic, Electrical and Seismic Methods of Mineral Exploration.

UNIT - IV

Ore Deposition - Physical and Chemical Controls of Ore fluids and their migration - Metallogenic Epochs and Provinces with Special reference to India – Ore beneficiation Processes - Physical Concentration Methods – Pre-treatment Processes: Drying, Calcination, Roasting, Agglomeration – Extraction via Flotation: Heap Leach Process, Smelting.

Course Outcomes

1 This course linked to industry and acquires knowledge on techniques to locate ore bodies, methods for mineral exploration and geologic aspects of drilling.
2 Acquire knowledge on geophysical methods for Ore reserve estimation.
3. Acquire knowledge on Ore beneficiation processes and techniques.

Textbooks/Reference Books:

1. Gokhale, K.V.G.K., and Rao, T.C., 1978: Ore deposits of India, Thompson Press, India.
2. Paul Ramdohr, 1970: Ore minerals and their intergrowth, Elsvier
3. R.L. Stanton, 1972: Ore petrology, McGraw-Hill Book Company, New York.
4. Lindgre, W: Ore deposits Stratabound Stratiform ore deposits, McGraw hill scientific company

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	M							
CO2	M	L	M	M	M							
CO3	M	L	M	M	M							

CO4	H	L	H	H	H							

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
FOURTH SEMESTER
SUBJECT: GEOLOGY
PAPER II – GEO.402: MINERAL EXPLORATION AND ORE BENEFICIATION

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Renewable resources
2. Mineralogical guides to locate resources
3. Objectives of mineral exploration.
4. Describe types of drills
5. Methods of sampling
6. Magnetic method of mineral exploration

7. Ore controls and guides
8. Physical and chemical controls of ore fluids.

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. a) Write an essay on conservation of minerals

Or

b) Explain the role of structural guides to locate the mineral resources

10. a) Briefly explain the Geobotanical methods of surface and sub surface explorations on different scales.

Or

b) Give a detailed an account of various types of drilling

11. a) Write a detailed note on seismic methods of mineral exploration

Or

b) Write an essay on calculations of statistical method

12. a) Write an essay on metallogenic epochs and provinces with special reference to India.

Or

b) Briefly explain the Ore beneficiation processes

GENERIC ELECTIVE: GEO.403a

MINING GEOLOGY

Course Objectives

1. To make students conversant with prevailing Mineral policies and acts
2. To understand different approaches of mineral exploration using different methods
3. To develop the capability to identify ore minerals and also design process flow charts in mineral processing.

UNIT- I

Mines and Minerals (Regulations and development) - Act ,1957 – National Mineral Policy - Mining Lease –Prospecting license – Renewal – Royalty and dead rent – Mineral concession rules (1960) – Certification of approval.

UNIT - II

Drilling: Percussion Drills, Rotary Drills, Miscellaneous Drilling methods, Drill Sampling, Accuracy of Sole Hole Sampling, Bore Hole Problems, Bore Hole Logging, Preservation and Sampling cares

UNIT – III

Mining methods: Classification of mining methods, Alluvial mining, Open cast mining or quarrying, Underground mining – Coal mining methods: Longwall advancing, Longwall retreating, Horizon mining, Strip mining and Miscellaneous mining.

UNIT - IV

Geochemical Prospecting: Metallic Mineral Deposits, Geochemical Field Techniques, Techniques used in Geobotanical Survey, Geochemical methods for Petroleum and Natural Gases Exploration – Ore Dressing: Crushing, Grinding, Sizing, Concentration; Washing and Scrubbing, Gigging, Tabling, Magnetic Separation, Electrostatic Separation – Flow Sheets: Chromite Gold, Copper and Lead and Zinc.

Course Outcomes

1. Confirm mining rules and regulations
2. Able to determine suitable mining methods
3. Analyse different ores and ore beneficiation processes.

Textbooks/Reference Books:

1. Abbas & Abbasi - Reneawable Energy Resources & their Implication. (Prentice Hall India)
2. Arogyaswamy, R.N.P. (1994): Course in Mining Geology. Oxford IBH– New Delhi.
3. Gupta, H.K., and Rastogi, B.K. (1976). Elements of Mining Technology Dhanbad publishers, Dhanbad.
4. Mckinstry, H.E. (1980). Mining Geology, Prentice Hall, N.Y.
5. R.W. Marjoribanks (1997). Geological methods in Mineral Exploration and Mining, Chapman & Hall, London.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	M							
CO2	M	L	M	M	M							

CO3	M	L	M	M	M							
CO4	H	L	H	H	H							

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
FOURTH SEMESTER
SUBJECT: GEOLOGY
PAPER III – GEO.403a: MINING GEOLOGY

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Definition of mining.
2. Mining lease and regulations.
3. Rotary Drills
4. Bore hole logging.
5. Alluvial mining.
6. Longwall Advancing.
7. Washing and Scrubbing
8. Magnetic Separation.

.

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. (a) Write an essay on Mineral Concession Rules, 1960.

Or

(b) Briefly explain the National Mineral Policy in India.

10. (a) Write an essay on various types of drilling methods.

Or

(b) Explain briefly about Drill sampling, Preservation and Sample cares

11. (a) Explain in detail the Open cast mining methods

Or

(b) Write an essay on Coal mining methods

12. (a) Discuss about the various types of Geochemical prospecting methods

Or

(b) Give an account on Ore dressing processes

.

GENERIC ELECTIVE: GEO. 403b

DIGITAL IMAGE PROCESSING

Course Objectives

1. To introduce the concepts of image processing and basic analytical methods to be used in image processing
2. To familiarize students with image enhancement and restoration techniques
3. To develop the capability to use GPS and DGPS instruments and technology

UNIT – I

Digital Number/pixel value - Image Rectification - Types of errors (Geometric, Radiometric and Atmospheric errors) – Corrections (Geometric, Radiometric and Atmospheric) – Image resampling – Resampling techniques - Computation of radiance and reflectance

UNIT – II

Image Registration - Image Enhancements, Spatial Enhancement, Radiometric Enhancement, Spectral Enhancement, Principal Component Analysis – Image Classifications: Digital Supervised classification, Unsupervised classification - Reclassification Processing and Feature Extraction – Data merging.

UNIT – III

Basic concepts of Global Navigational Satellite Systems (GNSSs) – Principle of GPS – Components of GPS - Source of GPS Errors and biases, Advantages and disadvantages of GPS surveying – GPS positioning types – Absolute positioning- Applications of GPS

UNIT – IV

Differential positioning – DGPS Measuring Techniques (Static, Rapid Static, Kinematic, Real Time Kinematic), Application of DGPS.

Course Outcomes

1. Analyze images in the frequency domain using various transforms.
2. Evaluate the techniques for image enhancement and image restoration.
3. Use GPS and DGPS techniques to various projects

Textbooks/Reference books:

1. Bernhardsen, T., 2002: Geographic Information Systems – An introduction. Wiley India.
2. Bonham, G. F and Carter. Geographic Information system for Geoscientists - Modelling with GIS, Elsevier.
3. Chandra, A.M. and Ghosh, S.K. 2007: Remote Sensing and Geographical Information Systems. Narosa Publishing House.
4. Estors, J.E. and Senger, L.W., 1974: RemoteSensing. Hamilton Publishing Company.
5. George Joseph: Fundamentals of Remote Sensing. Universities Press, Hyderabad.
6. Gupta, R. P. 2003: RemoteSensing Geology. Springer.
7. Heywood, I., Cornelius, S. and Carver, S. 2011: An Introduction to Geographical Information Systems, Pearson Prentice Hall, London.
8. Lillesand, T.M. and Keifer, R.W., 1979: Remotesensing and Image interpretation. John Wiley and Sons.
9. Lo C. P. and Yeung, A. K. W. 2002: Concepts and Techniques of Geographic Information Systems. Prentice Hall.
10. Panda, B. C. 2005: Remote Sensing – Principles and Applications. Viva Books Private Limited, New Delhi.
11. Pandey, S.N. 2001: Principles and Applications of Photogeology. New Age International (P) Limited Publishers, New Delhi.
12. Reddy, A.M., 2006: Textbook of Remote Sensing and Geographical Information Systems. B S Publications.
13. Rees W.G., 2001: Physical principles of Remote Sensing. Cambridge University Press.
14. Sabins, F.F., 1985: Remote Sensing–Principles and Applications. Freeman.
15. Seigal, B.S. and Gillespie, A.R., 1980: Remotesensing in Geology, John Wiley & Sons, 1980.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	M	L	M	H	M							
CO2	M	L	M	M	M							
CO3	M	L	M	M	M							
CO4	H	L	H	H	H							

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
FOURTH SEMESTER
SUBJECT: GEOLOGY
PAPER III – GEO.403b: DIGITAL IMAGE PROCESSING

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Atmospheric errors
2. Reflectance
3. Spatial Enhancement
4. Supervised classification
5. Principle of GPS
6. Absolute positioning
7. Source of GPS errors
8. DGPS kinematic measuring

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. (a) Explain the process of Image Rectification

Or

(b) Describe the image resampling techniques

10. (a) Give in detail the image enhancement techniques

Or

(b) Describe in detail the various image classifications

11. (a) Explain Basic concepts of Global Navigational Satellite Systems

Or

(b) Explain the components of GPS and its applications

12. (a) Describe the DGPS measuring techniques

Or

(b) Write an essay on applications of DGPS

GENERIC ELECTIVE: GEO. 403c

WATER RESOURCES MANAGEMENT

Course Objectives

1. To introduce the fundamentals of groundwater flow
2. To learn the hydraulics of various types of wells
3. To develop the skills to conduct groundwater investigations
4. To understand the impacts of seawater intrusion

UNIT- I:

Hydrologic cycle; Hydrological properties of rocks - Types of Aquifers: Unconfined, Confined, Semi Confined & Perched-Groundwater movements: Sub surface movement, Base flow, Effluent flow and influent flow - Darcy's law, Reynold's number, Laminar flow and turbulence flow.

UNIT - II

Pumping test: Objectives, layout of the test and measurements - Pumping Tests Methods, Estimation of T & S by Theis, Jacob and Theis Recovery, Methods, Specific Capacity Method by Slither's Method

UNIT - III

Water level fluctuation: Water Table fluctuations and causative factors; Water table and Piezometric surface and its fluctuations - Water Table Contour maps - Well types, drilling methods

UNIT - IV

Surface investigation of groundwater - Subsurface investigation of groundwater - Artificial recharge of groundwater: Concept and methods - Saline water intrusion in aquifers: Saline water intrusion, Ghyben – Herzberg relation between fresh and saline water, Prevention and control of salt water intrusion in the coastal aquifers.

Course Outcomes

1. Explain the distribution of groundwater
2. Estimate the yield of the wells
3. Assess the quantity and quality of groundwater

Textbooks/Reference Books:

1. Groundwater Hydrology by Todd, D.K. John Wiley & Sons. New York.
2. Hydrogeology by Karanth, K.R., Tata McGraw Hill Publ Co New Delhi.
3. Ground water assessment, Development and Management by Karanth K.R. Tata, McGraw Hill Publ. Co. New Delhi.
4. Keller, E.A., 1978. Environmental Geology. Bell and Howell, USA.
5. Subramanian, V., 2001.Textbook in environmental Science, Narosa Publication, New Delhi.
6. Hydrogeology by Davis, S.N. and Dewiest, R.J.M. John wiley & Son New York.
7. Ground Water by Raghunath, H. M. Wiley Eastern Ltd. New Delhi.
8. Groundwater Resources evaluation by Walton, W.C. McGraw Hill Publ. Co. New Delhi.
9. Groundwater Hydrology by Bouwer, H., McGraw Hill Book Co. New Delhi.
10. Davies, S.N. and De Wiest, D.R., (1966), Hydrogeology-John Wiley& sons, Inc, New York, 463p.
11. Fetter, C.W., (1990), Applied Hydrogeology-McGraw Hill, Publisher, New Delhi.
12. Freeze, R.A. and John, A., (1979), Groundwater, Cherry, Prentice Hall, Inc, 604p.
13. Handa, O.P (1984). Groundwater Drilling, Oxford & I.B.H. Publishing Co.
14. Hiscock, K., (2005), Hydrogeology, Principles and Practice, Blackwell Publishing, 389p.
15. Kazmann, (1973), Modern Hydrology, Harper and sons Publishers, New Delhi.
16. Manning, J.C., (2007). Applied Principles of Hydrology, CBS Publishers and Distributers, New Delhi.
17. Reddy and Rami, J.P., (2008). A Textbook of Hydrology, University Science Press, Bangalore.
18. Schwartz, F.W and Zhang, H., (2003). Fundamentals of groundwater, John Wiley&

sons, Inc, New York, 583p.
19. Shaw, E.M., (1994). Hydrology in Practice, 3rd edition, Chapman and Hall, London, 569p.
20. Tolman, C. (1972). Groundwater, McGraw Hill Book Company.
21. Walton, W.C. (1970). Groundwater Resource Evaluation, McGraw Hill Book Company.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	M							
CO2	M	L	M	M	M							
CO3	M	L	M	M	M							
CO4	H	L	H	H	H							

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
FOURTH SEMESTER
SUBJECT: GEOLOGY
PAPER III – GEO.403c: WATER RESOURCES MANAGEMENT

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Confined and unconfined aquifers
2. Effluent and Influent flows
3. Methods of pumping tests
4. Yield of a well
5. Differentiate water levels and water table
6. Factors influencing the water level fluctuation
7. Why saline water intrusion occurs
8. List the types of rainwater harvesting structures

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. a) Discuss the hydrological properties of rocks

OR

b) How many types of aquifers are present and their characteristics?

10. a) Explain the procedure of Theis recovery test

OR

b) Explain the procedure of specific capacity method by Slither's method

11. a) What is a Peizometric head? Discuss the factors affecting the Peizometric head

OR

b) What are the types of wells and Discuss different drilling methods

12. a) Discuss various surface investigation methods for groundwater

OR

b) Write the prevention and control methods of salt water intrusion in coastal aquifers.

PRACTICAL I – GEO.404P:

HYDROGEOLOGY AND ENGINEERING GEOLOGY
MINERAL EXPLORATION AND ORE BENEFICIATION
MINING GEOLOGY
HYDROGEOLOGY AND ENGINEERING GEOLOGY SYLLABUS:

Course Objectives:

1. To provide the basics of hydrological properties of rock, aquifers, source of groundwater pollution and artificial recharge structures
2. To analyze the quality of water
3. To design the groundwater movement
4. To conduct groundwater investigations, to insist on the management of groundwater and methods of groundwater recharge
5. Role of geologist in engineering projects geological consideration for the selection of sites for major engineering projects.

Syllabus:

1. Simple numerical problems related to: determination of permeability, Groundwater flow, Well hydraulics etc.
2. Preparation and interpretation of water level contour maps and depth to water level maps.
3. Study, preparation and analysis of hydrographs for differing groundwater conditions
4. Water potential zones of India (map study).
5. Graphical representation of chemical quality data and water classification (C-S and Trilinear diagrams).
6. Topomap study on topographic environment for ideal site and route selection for (i) Dams (ii) Reservoirs (iii) Canal alignment (iv) Check dams (v) Flood water

storage, (vi) Ghat roads

7. Preparation of Merits, demerits & remedial measures based up on geological cross sections of project sites
8. Identification of building stones and rock metal and study for physical and engineering properties.

Course Outcomes

1. Apply the knowledge of geological formations and the hydrological properties of rocks
2. Analyze the suitability of water for domestic, irrigation and industrial purposes Conduct geological and geophysical investigations and give recommendations for drilling of borewells.
3. Explain causes of pollution of groundwater give remedial measures to the society.
4. Use modern methods and appropriate techniques to carrying out geophysical studies and artificial recharge methods
5. Students will get critical knowledge on evaluation of geological condition at the major engineering project sites.

MINERAL EXPLORATION AND ORE BENEFICIATION SYLLABUS:

Course Objectives:

1. Knowledge on energy resources and guides to locate ore bodies.
2. To enhance knowledge on methods of sampling and open cast mining and underground mining methods.
3. Awareness on National Mineral Policy
4. To impart knowledge on mineral processing principles and techniques.
5. Role of geologist in engineering projects geological consideration for the selection of sites for major engineering projects.

Syllabus:

1. Preparation of Geological cross section based on Borehole data;
2. Laying down of stripping boundary on geological cross sections;
3. Calculation of geological and mineable ore reserves, mineable waste, and grade.
4. Interpretation of remote sensing data for mineral exploration.
5. Preparation of mineral maps of India,
6. Graphical representation of production, export and import of important minerals.

Course Outcomes

1. The purpose of mineral exploration is the discovery and acquisition of new mineral deposit amenable to economic extractive operations now or in future.
2. There is uncertainty on the supply side of the market because mineral exploration is risky and the results of investment in exploratory activity are difficult.
3. Exploration Results, Mineral Resources and Mineral Reserves for Oil Shales,. Oil Sands, and other energy minerals extracted by mining methods.
4. Mineral exploration is conducted to search for commercially viable concentrations of ores and minerals for mining purposes. A highly accurate

MINING GEOLOGY SYLLABUS:

Course Objectives:

1. Development and conservation of minerals. Encourage value addition of minerals through promotion of mineral based industries. Strengthen mineral administration. Enforcement of mineral laws and rules.

2. Geology is the first step in mining and involves identifying prospective mineral deposits that might become mines. Geology also helps mine managers know where to develop once the mine is up and running.

3. In mining geology, ore deposits resemble shale in that they are typically continuous resources across broad areas that vary in richness.

4. The students will gain knowledge about various mineral groups. Course Outcomes. CO1. Identify face, form, Axis, symmetry and laws of crystallography.

Syllabus:

1. Identification of anomaly
2. Concept of weighted average in anomaly detection
3. Geological cross-section
4. Models of reserve estimation
5. Study of existing mine plans and sketches

Course Outcomes

1. Our efforts towards this goal span the mining lifecycle: we utilize geological tools to address technical and socio-technical problems in mineral exploration,

2. They help us to develop new technologies and are used in our everyday lives. Our use

   of rocks and minerals includes as building material, cosmetics, cars, roads, and appliances.

3. In order maintain a healthy lifestyle and strengthen the body, humans need to consume minerals daily.

4. Geological exploration is fundamental to the discovery of a mineral deposit and establishing its viability from an exploitation perspective. Present-day geological studies involve the use of satellites and aerial photographs, as well as geophysical and geochemical techniques.

MULTIDISCIPLINARY COURSE: GEO. 405

ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT

Course Objectives

1. To impart knowledge on concept of environmental impact assessment
2. To prepare the database for planning and management of EIA
3. To develop the skills to prepare mitigation measures
4. To understand the Various Acts related to Environment audit

UNIT - I

Concept and Scope of EIA – Elements and methodologies of EIA – Classification of environmental parameters – Public participation in environmental decision making process – Planning and management of EIA – Criteria for the selection of EIA methodology

UNIT- II

Procurement of relevant soil quality data, impact prediction, assessment of impacts significance, Identification and incorporation of mitigation measures

UNIT- III

Procurement of relevant Air, Wild life and other Ecosystem quality data, impact prediction, assessment of impacts significance, Identification and incorporation of mitigation measures

UNIT - IV

Need of Environmental audit – Importance of environmental legislation – Classification of environmental audit – Audit data and report - The Air Act – The Environmental Protection Act – The water Act – Wild life Act - Case studies.

Course Outcomes

1. Explain and evaluate the EIAM report
2. Estimate the cost benefit ratio of a project
3. Assess the risks and impacts of a project
4. Identify suitable EIA methodology

Textbooks/Reference Books:

1. H.S. Bhatia, 2003: A Text Book of Environmental Pollution and Control - Galgotia Publications (P) Ltd, New Delhi.
2. Larry, W. Canter, 1977: Environmental Impact Assessment - McGraw-Hill publications.
3. Anjaneyulu, Y. and Manickam, V, 2017: Environmental Impact Assessment Methodologies – B.S. Publication.
4. Balakrishna Moorthy, 2008: Environmental Management, 2nd Edn – PHI Publications.
5. B.B. Hosetti, and A. Kumar, 1998: Environmental Impact Assessment and Management - Daya Publishing house.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	M							
CO2	M	L	M	M	M							
CO3	M	L	M	M	M							
CO4	H	L	H	H	H							

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
FOURTH SEMESTER
SUBJECT: GEOLOGY
PAPER IV – GEO.405: ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Elements of Environmental Impact Assessment and management
2. Concept of EIAM
3. Significance of Soil data in EIAM studies
4. Assessment of impact on soils
5. Significance of Air quality data in EIAM studies
6. Mitigation measures of impact on ecosystem
7. Environmental audit data
8. Air Act

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. a) Classification of environmental parameters in EIA studies

   OR

   b) Explain the role of public participation in environmental decision making process

10. a) Write the procedure for the Identification and incorporation of mitigation measures in case of Soil quality

    OR

    b) Write the procedure for impact prediction and assessment of impact's significance done in case of water quality

11. a) Write the procedure for impact prediction and assessment of impact's significance done in case of Air quality

OR

b) Write the procedure for impact prediction and assessment of impact's significance done in case of Ecosystmes

12. a) Discuss the classification of environmental audit in detail

OR

b) Write a note on Water act and Environmental protection act

PRACTICAL II – GEO.406P: GEOLOGICAL FIELD SURVEY AND TRAINING PROGRAMME

Course Objectives:

1. Geology is the one of the most interesting subject about mother earth which can be best studied on field.
2. Geological Survey is the nation's largest water, earth, and biological science and civilian mapping agency.
3. It collects, monitors, analyzes, and provides scientific understanding of natural resource conditions, issues, and problems.
4. The **geological** map of the region given to us was thoroughly studied so that we could get an idea of the important rock

Syllabus:

1. To carryout yield test of a bore well in the field.
2. Collection of water level data of various wells in the field.
3. Visit to a dam or a bridge or any other major engineering structures to understand the geological conditions in and around the engineering structures.
4. Visit to open cast or underground ore forming rock mining areas to understand the mining operations.
5. Preparation of field report (draft) incorporating the above said geological characteristics in the field.

Course Outcomes:

1. Traditional **field geological surveys** include searching for geological outcrops, surveying various geological phenomena.
2. A geological survey is the systematic investigation of the geology beneath a given piece of ground for the purpose of creating a geological map or model.
3. The management of **geological** data has been one of the important **research fields** in engineering **geology**, geotechnical engineering, and Geographic Information
4. Program outcomes examine what a program or process is to do, achieve, or accomplish for its own improvement and/or in support of institutional or divisional goals: generally numbers, needs, or satisfaction driven. They can address quality, quantity, fiscal sustainability, facilities and infrastructure, or growth.

OPEN ELECTIVE: GEO.407a

FUEL GEOLOGY

Course Objectives

1. To impart knowledge about the origin, composition and accumulation of petroleum; reservoir rock types and reservoir traps.
2. To know geology of oil bearing basins of India, position of oil and gas in India and future prosepects and economic scenario.
3. To educate about the coal characteristics, geographical distiribution of coal and detailed geolology of coal fields of India.
4. To enlighten about the occurrence and association of atomic minerals, methods of prospecting and Nuclear power stations country and future prospects.

UNIT- I:

Petroleum: Composition – nature - origin: inorganic and organic theories - migration

(primary and secondary) and accumulation of oil and gas - Geographic locations - petroleum reservoir rocks - Reservoir rock types, Geological age of reservoir rocks - Reservoir traps - Classification of traps, anticlinal theory - Structural traps caused by folding, faulting and fracturing.

UNIT- II:

Primary stratigraphic traps - Fluid traps, Salt domes, Salt plugs, Cap rocks and association traps: Origin, reservoir conditions - Oil bearing basins of India - Geology of the productive oil fields of India - Position of oil and natural gas in India - Future prospects and economic scenario.

UNIT- III:

Coal: Definition, origin, sedimentology of coal bearing strata - Rank, grade and type of coal - Chemical characterization: Proximate and ultimate analysis - Coal forming epochs in the geologic past - Geological and geographical distribution of coal in India - Detailed geology for important coal fields in India.

UNIT- IV:

Atomic minerals: Mode of occurrence and association of atomic minerals in nature - Atomic minerals as source of energy - Methods of prospecting and productive geological horizons in India - Nuclear power stations of country and future prospects - Atomic fuels and environment.

Course Outcomes

1. The course offers a detailed study about natural fuels like coal and petroleum their formation and distribution especially in sedimentary basins.
2. Students shall benefit to have basic ideas about formations, nomenclature in constitution of coal working detail of distribution of coals and coal industry in India, Sufficient idea offormation and entrapment of oil and gas.
3. Get elaborate knowledge about occurrence of atomic minerals in nature, methods of prospecting, atomic fuels and environment.

Textbooks/Reference Books:

1. Taylor, G.H., Teichmueller, M., Davis, A., Diesel, C.F.K. and others, 1998: Organic Petrology, Berlin – Stuttgart.
2. Selley, R.C., 1985: Elements of Petroleum Geology, Academic Press
3. Chandra, D., Singh, R.M and Singh, M.P: Textbook of Coal
4. Singh, M.P: Coal and Organic Petrology
5. Stach, E, Mackowsky, M.T.H, Taylor, H.H and others, 1982: Stach's Textbook of Coal Petrology
6. Durrance, E.M., 1986: Radioactivity in Geology: Principles and Applications, Ellis

Horwood Ltd.
7. Scott, A.C., (1987): Coal and Coal-bearing strata: Recent Advances. The geological Society of London, Publication no. 32, Blackwell scientific Publications.
8. Holson, G.D. and Tiratso, E.N., (1985): Introduction to Petroleum Geology. Gulf Publishing, Houston, Texas.
9. North, F.K., (1985): Petroleum Geology. Allen Unwin.
10. Dahlkamp, F.J., (1993): Uranium Ore Deposits. Springer Verlag.
11. VBoyle, R.W., (1982): Geochemical prospecting for Thorium and Uranium deposits, Elsevier

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	M							
CO2	M	L	M	M	M							
CO3	M	L	M	M	M							
CO4	H	L	H	H	H							

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
FOURTH SEMESTER
SUBJECT: GEOLOGY
PAPER V – GEO.407a: FUEL GEOLOGY

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Origin of Petroleum
2. Geographic locations of Petroleum
3. Origin of cap rocks
4. Salt domes
5. Hydrocarbon evaluation
6. Coal petrology
7. Radioactive minerals
8. Occurrence of atomic minerals

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. a) Write an essay on surface and subsurface occurrence of petroleum and gas

(OR)

b) Describe the migration and accumulation of oil and gas

10. a) Describe various types of stratigraphic traps with neat sketch

(OR)

b) Enumerate the geology of the oil fields in India

11. a) Write an essay on preparation of coal for industrial propose

(OR)

b) Discuss about Indian coal reserves and production of coal in India

12. a) Write a detailed note on Atomic fuels and environment

(OR)

b) Give an account of productive geological horizons of atomic minerals of India

OPEN ELECTIVE: GEO.407b

NATURAL HAZARDS AND DISASTER MANAGEMENT

Course Objectives

1. To understand the origin and types of disasters
2. To Compare hazards, disasters and associated natural phenomena and their interrelationships, causes and their effects
3. To build skill to respond to disasters

UNIT - I

Natural Hazard - definition - Earth's processes: catastrophic geological hazards: study of floods, Landslides, Earthquakes, Volcanism and avalanches – with a view to assess the magnitude of the problem, prediction and perception of the hazards - Laws and regulations towards hazard management.

UNIT - II

Earthquakes: Definition - seismic waves, intensity and magnitude, Richter scales, Seismograph, seismogram, seismicity in Indian region, mitigation measures and management, Preparation of seismic hazard map – **Tsunamis:** Causes, General

characteristics, Predictability, effects, Possible Risk Reduction Measures – **Volcanoes:** Definition, types, mitigation measures and management - **Avalanche:** Definition, types, mitigation - **Flood:** Definition, causes, vulnerable zones in India, Mitigation measures and management

UNIT - III

Coastal Hazards: Introduction, Coastal Processes, Coastal erosion, mitigation measures and management - **Landslides:** Types, Causes and mechanism, Vulnerable zones in India, mitigation measures and management – **Cyclone:** Definition, Causes, Vulnerable zones in India, mitigation measures and management - **Soil erosion:** Soil formation, Soil classification, Factors influencing Soil erosion, Hazards of Soil erosion – **Drought:** Types, Mitigation Measures.

UNIT - IV

Pre-planning for a Disaster: Internal Actions, External Actions – Eliminating, minimizing and shifting risks – Developing an Action plan – Developing the written plan – Effective Communication – Selecting the right people – Training for Success – Media control - Shareholder factor – **After a Disaster**; Minimizing the Damage – Governmental reactions – Disaster Preparedness Assessments.

Course Outcomes

1. Identify the natural and environmental disasters, its causes and apply preventive measures.
2. Adoptthe laws and regulations towards hazard management
3. Able to prepare controls of mitigating toward natural disasters.

Textbooks/Reference Books:

1. K. S. Valdiya, 2013: Environmental Geology, McGraw Hill Education (India)
2. D. Collins Larry, R. and Schneid Thomas, D., 2000: Disaster Management and Preparedness, Taylor and Francis.
3. Goel, S.L. and Kumar Ram, 2000: Disaster Management, Deep and Deep Publications.
4. Living with Risk: A global review of disaster reduction initiatives, 2004 Vision, United Nations.
5. Parasuraman, S., 2004: India Disasters Report: Towards a Policy Initiatives, Oxford University Press.

CO – PO Mapping:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	M							
CO2	M	L	M	M	M							
CO3	M	L	M	M	M							
CO4	H	L	H	H	H							

H: High; M: Medium; L: Low

MODEL QUESTION PAPER

(*Revised Syllabus w.e.f. 2021-2022 for Campus Students)*

M.Sc. DEGREE EXAMINATION - 2022
FOURTH SEMESTER
SUBJECT: GEOLOGY
PAPER V - GEO.407b: NATURAL HAZARDS AND DISASTER MANAGEMNET

Time: 3 hrs **Max. Marks: 80**

SECTION – A

Answer any FOUR of the following questions. All questions carry equal marks ***4 X 5 = 20 M***

1. Earthquake Magnitude and Intensity
2. Define Avalanche. Explain the causes of Avalanche.
3. Tsunami
4. Seismic waves and Richter Scale
5. Coastal processes
6. Define Flood and explain its causes
7. Pre-planning for a Disaster
8. Media control in an emergency and Disaster preparedness plan

SECTION – B

Answer ALL questions. All questions Carry equal Marks ***4 x 15 = 60 M***

9. a) List out and Briefly describe different geological hazards

OR

b) Discuss the Governing Laws and Regulations towards Hazard Management

10. a) Define Earthquake. Explain its causes, mitigation measures and management

OR

b) Define Volcano and explain mitigation measures and management in Volcanic Regions.

11. a) Define Avalanche. Explain its types and mitigation measurements to control the disaster.

OR

b) Discuss causes of Coastal erosion and its mitigation measures and management

12. a) Explain the Pre-planning measures for a disaster management

OR

b) Discuss in detail how to minimize the damage after a disaster.

Revised syllabus- **(M.A.HINDI SYLLABUS)**

Semester-I

Components of Study	Title of the Course	Hrs	Credits	IA	Sem. Exams	Total
Core-Mandatory	101-Sahitya ka Itihas	6	4	20	80	100
	102-Pracheen evam Madhaykaleen Kavya	6	4	20	80	100
	103-Aadhunik Kavita	6	4	20	80	100
	104-Samkaleen Kavita	6	4	20	80	100
Compulsory Foundation-Opt. 1	105-A-Samsamyik Kavita	6	4	20	80	100
	B-Sahityandolan	6	4	20	80	100
	C-Sahitya ki Vaichariki	6	4	20	80	100
Elective Foundation Opt. 1	106-A- Bhasha Vignan aur Hindi Bhasha	6	4	20	80	100
	B-Patrakarita aur Jansanchar madhayam	6	4	20	80	100
Audit Course	107-Human Values & Professional Ethics-I	0	0	00	00	000

Semester-II

Core-Mandatory	201-Aadhunik Sahitya ka Itihas	6	4	20	80	100
	202-Katha Sahitya	6	4	20	80	100
	203-Nataya Sahitya	6	4	20	80	100
	204-Aalochana Sahitya	6	4	20	80	100
Compulsory Foundation Opt. 1	205-A-Gadhya Sahitya	6	4	20	80	100
	B-Anya Gadhya Sahitya	6	4	20	80	100
	C- Andhra ka Hindi Sahitya	6	4	20	80	100
Elective Foundation Opt.1	206-A-Prayojanmulak Hindi aur Rajbhasha	6	4	20	80	100
	B-Anuvad ke Sidhanta aur Prayog	6	4	20	80	100
Audit Course	207- Human Values & Professional Ethics-II	0	0	00	00	000

Semester-III

Core-Mandatory	301-Bhartiya Kavya Shastra ki Parampara	6	4	20	80	100
	302- Hindi Kavya Shastra ka Vikas	6	4	20	80	100
Generic Elective Opt. 2	303-A-Dalit Sahitya`	6	4	20	80	100
	B-Aadivasi Sahitya	6	4	20	80	100
	C- Narivadi Sahitya	6	4	20	80	100
	D- Pravasi Sahitya	6	4	20	80	100
Skill Oriented Course-Mandatory	304-Bhasha Shikshan ke Sidhanta aur Prayog	6	4	20	80	100
Open Elective Opt. 1	305-A-Vyavharik Hindi Vyakaran	6	4	20	80	100
	B-Hindi Sahitya ke Nirmata	6	4	20	80	100

Semester-IV

Core-Mandatory	401-Bhartiya Tulnatmak Sahitya	6	4	20	80	100
	402-Paschatya Samiksha Shastra	6	4	20	80	100
Generic Elective Opt. 2	403-A-Anudit Bhartiya Sahitya	6	4	20	80	100
	B-Asmitamulak Sahitya Vimarsha	6	4	20	80	100
	C-Sahitya ka Tulnatmak Adhayayan	6	4	20	80	100
	D-Anusandhan ke Sidhanta aur Dristiya	6	4	20	80	100
Multidisciplinary Course- Mandatory	404-AntarJananushasnatmak Dristiya aur Pravidhiya	6	4	20	80	100
Open Elective Opt. 1	[illegible] aur Nagrilipi	6	4	20	80	100
	[illegible] Hindi Sahitya ke Nirmata	6	4	20	80	100

REDMI NOTE 5 PRO
MI DUAL CAMERA

SRI VENKATESWARA UNIVERSITY
Tirupati-517 502
Master of Arts
Subject: HISTORY

CBCS Pattern
(With effect from 2021-22)
The Courses of Study and the Scheme of Examinations

SEMESTER -I

	Components of Study	Course Number	Title of the Course	Instruction hours per week	Credits	IA Marks	End Semester Exam Marks	Total
SEMESTER- I	Core	HST 101	History of India Up to 650 A D	6	4	20	80	100
		HST 102	History of Indian Polity and Economy, 1206-1757	6	4	20	80	100
		HST 103	History of Modern India, 1757 – 1947	6	4	20	80	100
		HST 104	History of Modern World, 1900-1945	6	4	20	80	100
	Compulsory Foundation	HST 105 (A)	History of Andhras up to 1336 A D	6	4	20	80	100
		HST 105 (B)	History of World Civilizations	6	4	20	80	100
	Elective Foundation	HST 106 (A)	Theoretical Concepts of Tourism	6	4	20	80	100
		HST 106 (B)	History of Medieval World	6	4	20	80	100
	Audit Course*	HST 107	Human Values and Professional Ethics-I.			**0**	**0**	**100**

* All **Core** Papers are **Mandatory**
*Compulsory Foundation – Choose **One** paper
*Elective Foundation - Choose**ONE**
*Audit Course – 100 Marks (Internal) – Zero Credits under self study
*Interested students may register for MOOC with the approval of the concerned DDC but it will considered for the award of the grade as open elective only given extra credits

SEMESTER -II

	Components of Study	Course Number	Title of the Course	Instruction hours per week	Credits	IA Marks	End Semester Exam Marks	Total
SEMESTER II	Core	HST 201	History of India 650-1206 A D	6	4	20	80	100
		HST 202	Social and Cultural History of India, 1206-1757	6	4	20	80	100
		HST 203	Freedom Movement in India, 1857 –1947	6	4	20	80	100
		HST 204	History of Contemporary World, 1945-2000	6	4	20	80	100
	Compulsory Foundation	HST 205	A) History of Vijayanagara Empire B) History of Modern Africa	6	4	20	80	100
	Elective Foundation	HST 206	A) Historical Application of Tourism in India B) Women Studies in Modern India	6	4	20	80	100
	Audit Course*	HST 207	Human Values and Professional Ethics-II			**0**	**0**	**100**

* All **Core** Papers are **Mandatory**
*Compulsory Foundation – Choose **One** paper
*Elective Foundation - Choose**ONE**
*Audit Course – 100 Marks (Internal) – Zero Credits under self study
*Interested students may register for MOOC with the approval of the concerned DDC but it will considered for the award of the grade as open elective only given extra credits.

SEMESTER -III

	Components of Study	Course Number	Title of the Course	Instruction hours per week	Credits	IA Marks	End Semester Exam Marks	Total
SEMESTER-III	Core	HST 301	Historical Method and Concepts	6	4	20	80	100
		HST 302	Contemporary History of India-I	6	4	20	80	100
	Generic Elective (Related to Subject)	HST 303(A)	History of USA, 1776- 1963	6	4	20	80	100
		HST 303(B)	History of Modern Andhra, 1766 –1972	6	4	20	80	100
		HST 303(C)	Indian Foreign Policy: An Introduction	6	4	20	80	100
		HST 303(D)	Environmental History of Modern India	6	4	20	80	100
	Skill Oriented Course	HST 304	Communication and Soft Skills	6	4	20	80	100
	Open Elective (For other Departments	HST 305 (A)	Economic and Cultural History of India, 1757-1857	6	4	20	80	100
		HST 305(B)	Intellectual History of 19th Century India	6	4	20	80	100

* All **Core** Papers are **Mandatory**
***Generic Elective** – Choose **Two** papers
***Skill Oriented** course is **Mandatory**
***Open Electives** are for the Students of other Departments. Minimum **One Paper** should be opted. Extra credits may be earned by opting for more number of open electives depending on the interest of the student through self study.
*Interested students may register for MOOC with the approval of the concerned DDC.

SEMESTER –IV

	Components of Study	Course Number	Title of the Course	Instruction hours per week	Credits	IA Marks	End Semester Exam Marks	Total
SEMESTER-IV	Core	HST 401	Historiography	6	4	20	80	100
		HST 402	Contemporary History of India-II	6	4	20	80	100
	Generic Elective (Related to Subject)	HST 403(A)	International Relations and Organizations	6	4	20	80	100
		HST 403(B)	Constitutional History of India, 1773-1950	6	4	20	80	100
		HST 403(C)	History of Modern Asia 1868-1960	6	4	20	80	100
		HST 403(D)	History of Modern Latin America	6	4	20	80	100
	Multidisciplinary Course/Project	HST 404	History of Science and Technology in India 1858-1947	6	4	20	80	100
	Open Elective (For other Departments	HST 405(A)	Outlines of Andhra History and Culture	6	4	20	80	100
		HST 405 (B)	Health, Medicine and Society in Modern India	6	4	20	80	100

* All **Core** Papers are **Mandatory**
*Generic Elective – Choose **Two** papers
*Multidisciplinary/ Project Work is **Mandatory**
*Open Electives are for the Students of other Departments. Minimum One Paper should be opted. Extra credits may be earned by opting for more number of open electives depending on the interest of the student through self study.
*Interested students may register for MOOC with the approval of the concerned DDC.



SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING:
TIRUPATI -517502
(AUTONOMOUS)

DEPARTMENT OF MECHANICAL ENGINEERING
(Choice Based Credit System)

R23

POST GRADUATION PROGRAM

MASTER OF TECHNOLOGY
in
INDUSTRIAL ENGINEERING (IE)
&
PRODUCTION ENGINEERING (PE)

Scheme of Instructions and Evaluation
(With effect from the Academic Year 2023-24)



SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING:
TIRUPATI -517502
(AUTONOMOUS)

DEPARTMENT OF MECHANICAL ENGINEERING
(Choice Based Credit System)

R23

POST GRADUATION PROGRAM

MASTER OF TECHNOLOGY
in
INDUSTRIAL ENGINEERING

Scheme of Instructions and Evaluation
(With effect from the Academic Year 2023-24)

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502
DEPARTMENT OF MECHANICAL ENGINEERING-SCHEME OF INSTRUCTION- (CBCS) EFFECTIVE FROM THE ACADEMIC YEAR:2023-2024

M.TECH (PG) SPECIALIZATION: INDUSTRIAL ENGINEERING

I-SEMESTER

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	IE11C	Operations Planning and Control	3	1	0	4	4	40	60	100
PCC	IE12C	Work System Design	3	1	0	4	4	40	60	100
PCC	IE13C	Facilities Planning	3	1	0	4	4	40	60	100
PEC	IE14C	Programme Elective- I	3	0	0	3	3	40	60	100
PEC	IE15C	Programme Elective- II	3	0	0	3	3	40	60	100
PCC	IE16L	Industrial Engineering Lab-I	0	0	3	3	1.5	40	60	100
PCC	IE17L	Simulation Lab – I	0	0	3	3	1.5	40	60	100
MC	IE18C	Research Methodology and IPR	3	0	0	3	3	40	60	100
	Total		**18**	**3**	**6**	**27**	**24**	**320**	**480**	**800**

List of Programme Elective					
Course Title	**I**	**Applied Probability and Statistics**	**Financial Management & Control**	**Human Resource Management**	**Expert Systems in Manufacturing**
	II	**Design for Manufacturing**	**Marketing Management**	**System Dynamics**	**Enterprise Resource Planning**

II-SEMESTER

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	IE21C	Advanced Operation Research	3	1	0	4	4	40	60	100
PCC	IE22C	Quality Control and Reliability Engineering	3	1	0	4	4	40	60	100
PEC	IE23C	Programme Elective Course – III	3	0	0	3	3	40	60	100
PEC	IE24C	Programme Elective Course – IV	3	0	0	3	3	40	60	100
PCC	IE25L	Industrial Engineering Lab-II	0	0	3	3	1.5	40	60	100
PCC	IE26L	Simulation Lab – II	0	0	3	3	1.5	40	60	100
MC	IE27C	Value Added course	3	0	0	3	3	100	-	100
PCC	IE28P	Mini Project with Seminar	1	0	2	3	2	100	-	100
	Total		**16**	**2**	**8**	**26**	**22**	**440**	**360**	**800**

List of Programme Elective					
Course Title	**III**	**Supply Chain Management**	**System Simulation**	**Project Management**	**Intelligent Manufacturing Systems**
	IV	**Productivity Engineering & Management**	**Logistics Engineering & Management**	**Service Engineering & Management**	**Energy Management**

Value Added course				
Course Title	**I**	Leadership Qualities for Engineers	Stress Management	Universal Human Values

III-SEMESTER

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
OEC	CSP32C	Open Elective Course (MOOCs)	0	0	0	0	3	100	-	100
PCC	CSP33I	Industrial/ Research Internship (Min of 4 Weeks)	0	0	0	0	3	100	-	100
PCC	CSP34J	**Dissertation Work Phase-I**	0	0	24	24	12	40	60	100
	Total		**0**	**0**	**20**	**20**	**18**	**240**	**60**	**300**

IV-SEMESTER

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	CSP41J	**Dissertation WorkPhase-II and Viva-Voce**	0	0	20	20	10 + 06 = 16	40	60	100
	Total		**0**	**0**	**20**	**20**	**16**	**40**	**60**	**100**

IE11C OPERATIONS PLANNING AND CONTROL
M. Tech I- SEMESTER
INDUSTRIAL ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 3-1-0-4

COURSE CONTENT:

Unit -I

OPC is a system approach—types of production and OPC functions. Forecasting: Forecasting Methods — Qualitative Methods — Quantitative methods— moving average and exponential smoothing methods for different data patterns. Forecast errors, Tracking signal.

Unit -II

Mass Production Management Principles of flow lines, Assembly line balancing, approach to line balancing — RPW, COMSOAL, Integer, and Dynamic programming formulations. Introduction to transfer lines.Production Planning Linear programming formulations for static demand cases, Product Mix Decisions. Chance- constrained programming models.

Unit -III

Aggregate Production Planning Production planning under dynamic conditions strategies, costs involved Heuristic methods, linear production, and inventory programs. Aggregate production planning — HMMS model, search decision, parametric production planning, management coefficient models. Disaggregation — hierarchical planning, mathematical programming formulations. Master Production Schedule.

Unit -IV

Operations Scheduling Flow shop sequencing and job scheduling. Periodic review models. Continuous review models, lot size models with dynamic demand, and inventory models of spare parts.

Unit -V

Materials Requirement Planning (MRP) Introduction. Inventory in a manufacturing environment. Principles of MRP, MRP processing logic. MRP systems, and MRP-II,Jut-In-Time manufacturing: set-up reduction, stable MPS, and Kanban control.

COURSE OUTCOMES:

From this course, students will be able to

1. Describe Forecasting principles and techniques for short-range and long-range planning
2. Analyse Production requirements for each product and plan the shop floor activities
3. Elaborate Work station loading and scheduling of paths to avoid bottlenecks for smooth production
4. Design Solution for product mix decision using OR techniques.
5. Analyse optimal job sequences to achieve the minimum makespan with maximum production

REFERENCES

1. Montgomery, Operations Research in Production Planning, Scheduling and Inventory Control — Prentice Hall, N.J
2. Buffa, E.S., Operations Management — John Wiley & Sons.
3. Elsyod and Boucher Analysis of Production Systems, Prentice Hall, N.J,ISE Series
4. Burbridge, Production Planning — Heinemann Publishers, 1971.

IE12C WORK SYSTEM DESIGN
M. Tech I- SEMESTER
INDUSTRIAL ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 3-1-0-4

COURSE CONTENT:

UNIT-I

Method study: Purpose of work-study-Objectives, applications, Method study definition & basic procedure selection of job, Various recording techniques like outline process charts, flow charts, Man machine charts, Two handed process charts, sting diagram, flow diagram, Multiple activity chart, Simo, Cycle-graphs and chrono-cycle graphs, Critical examination, development and maintenance of improved methods.

UNIT-II

Micro motion studies: Use of fundamental hand motions- principles of motion economy and work place layout, Process planning and design of jigs and fixtures. Applications of method study in office and other diverse functional areas for development and implementation of work systems.

UNIT-III

Ergonomics-Introduction to ergonomics and human engineering, physical basis of mans Perception of his environment. Anthropometry and work design, studies on human psycho sensorial processes for design of work systems.

UNIT-IV

Work Measurement-Work measurement objectives and techniques, time study and rating systems, allowances, standard and allowed time, production norms, production study, activity sampling development of synthetic and standard data, application of work study in non — traditional areas like hospitals, public utilities, etc.

UNIT-V

Principles of predetermined motion time systems (PMTS). The MTM system, its history and development, basic motions and their control characteristics, simultaneous and combined motions, limiting motions, learning curve concepts, application of PMTS & MTM.

COURSE OUTCOMES:

At the end of the course student will be able to

1. Apply the work study procedures and analyse the methods using various recording techniques.
2. Use principles of motion economy and apply the method study in diverse functional areas for development and implementation of work systems.
3. Understand the concept of anthropometry and work system for ergonomic design of work systems
4. Estimate the standard time for a given task using different work measurement systems.
5. Apply the concepts of learning curves, PMTS & MTM to reveal the existence of ineffective time.

REFERENCES

1. Mundel, Motion and Time Study,PHI,1973
2. Niebel, Motion and Time Study. USA Edition
3. Barnes, Motion and Time Study — Design and Measurement of Work.
4. Hank Book of industrial Engineers by H.BMaynard
5. Work study and Ergonomics - S.K. Sharma and Savita Sharma
6. Workstudy – Suresh Dalela

IE13C FACILITIES PLANNING
M. Tech I- SEMESTER
INDUSTRIAL ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 3-1-0-4

COURSE CONTENT:

UNIT-I

Facilities Planning: Definition, Significance, Objectives and process of facilities planning — strategic facilities planning; Relationship between product, process and schedule design and facilities planning. Activity relationships and space requirements planning personnel requirements.

UNIT-II

Material Handling: Definition, principles, system design and selection of equipment, unit load concepts. Basic layout types — Immer, Nadler, Muther Apple James and Ree's approaches to plant layout. Modular design concept. Production Line balancing.

UNIT-III

Computer Aided Layout: CRAFT, COFAD, PLANET, CORELAP, ALDEP. Planning for receiving and shipping, storage and ware housing, manufacturing, office planning, facility services and non — manufacturing functions.

UNIT-IV

Quantitative Approaches to facilities Planning: Deterministic models - single and multi - facility location models. Location - Allocation problems - quadratic assignment problem. Warehouse layout models. Plant location problems. Conveyor models. Storage models.

UNIT-V

Probabilistic models: Conveyor models, waiting line models simulation models and storage models Evaluation, selection, implementation and maintenance of the Facilities plan.

COURSE OUTCOMES:

1. Able to know the concept of facilities planning that aid in design of Product, Process and schedule design.
2. Able to design Material handling equipment for industrial and non-industrial purpose.
3. Able to analyse handling, receiving and shipping of goods using computer aided layout software.
4. Able to solve Problems of ware house, conveyor and allocation models using Quantitative approach.
5. Able to simulate the waiting line models, storage models and conveyor models using simulation software.

REFERENCES

1. Tompkins. J.A. and White, J.A., Facilities Planning.John Wiley& Sons
2. Francies, R.L., and Mc Ginnis White, J.A., Facility Layout and Location — Ananalytical approach, PHI Publications

IE14C APPLIED PROBABILITY AND STATISTICS
M.Tech I SEMESTER
INDUSTRIAL ENGINEERING
Common to Industrial Engineering & Production Engineering
(Programme Elective- I)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Introduction to probability: Probability, sample space — axioms of probability, Random variables — Discrete and Continuous — Expectations — Moment Generating functions. Conditional probability — Bayer's theorem — Independent Events.

UNIT-II

Discrete distributions: Binomial, Hyper geometric, Gama, Students t, Chi-square, Weibell distributions. Bivariate random variables and their distributions (with specific reference to bivariate normal distributions only). Conditional distributions — Covariance, Correlation coefficient — Regression of the mean.

UNIT-III

Functions of random variables: Probability distribution of functions of random variables their joint probability distribution.

Sampling: Sampling Distribution — Law of Large Numbers — Central Limit theorem.

UNIT-IV

Estimation: Point Estimation, Interval Estimation and Confidence Intervals. (Maximum Likelihood Estimation), Bayesians Estimation.

Testing of Hypothesis: Simple hypothesis and the Neyman — Pearson lemma — Composite hypothesis — goodness of fit tests.

UNIT-V

Analysis of variance: One way classification — Randomized, complete block designs

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Understand the basic concept of probability.
2. Explain random variables for discrete and continuous probability estimation.
3. Define sampling theory, apply it to predict the event, and analyze the statistical distributions.
4. Analyse different Estimations and Testing of hypothesis
5. Apply the concepts of analysis of variance for the Correlation between the observed and experimental values.

REFERENCES

1. Ian F. Blake, An introduction to Applied Probability — John Wiley & Sons
2. Milton, J.S., Arnold, Jee C., Probability and Statistics in the Engineering andComputing Sciences — Mc Grawhill, 2003.

IE14C FINANCIAL MANAGEMENT AND CONTROL
M.Tech I SEMESTER
INDUSTRIAL ENGINEERING
(Programme Elective- I)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Goals and functions of Finance; Concepts in Valuation, Time Value of Money. Principles of Capital budgeting generating of cash flows. Evaluation of investment proposals — Capital rationing and mathematical programming of Capital Budgeting.

UNIT-II

Cost of capital for specific sources of financing and weighted average cost of capital. Evaluation of Risky investments — Generation of information needed to evaluate risky investments when cash flows are independent, sequential decisions and decision trees. Abandonment problems evaluation of projects under firm risk concepts.

UNIT-III

Working capital management — factor, principles short term Vs. long term financing, liquidity of assets and evaluation of alternative ways of financing on the liquidity of firms. Management of Cash and marketable securities management of cash lock box and concentration banking cash management, models of Bumol, Miller and Off, Management of accounts receivable credit collection policies, Evaluating credit applicant, inventory control and financial manager.

UNIT-IV

Cost accounting — Elements of cost, types of methods of costing. Overhead charges and allocation, standard costing and budgetary control/marginal costing. Cost variances — methods of calculating variances. Material, Labour, Expenses and indirect expenses preparation of cost sheets and their usages.

UNIT-V

Tools of financial analysis — financial ratio analysis, Funds flow analysis and financial forecasting, analysis of operating and financial leverage.

COURSE OUTCOMES:

At the end of the course student will be able to

1. Analyse the time value of money, and evaluate the investment proposals and use of different capital budgeting methods.
2. Interpret financial data for the purpose of constructing risk assessment and evaluation of projects under firm risk.
3. Take both long-term and short-term financing decisions and understand the management of Cash and marketable securities management.
4. Understand the several methods of costing, preparation of cost sheets and their usages methods.
5. Apply the tools of financial analysis methods to measure the operating efficiency of business.

REFERENCES

1. Vanhorne, James. C. Financial Management and Policy — Pearson Education.
2. Pandey, I. M., Financial Management
3. Humpton, Financial Decision Making (Concepts, problems and cases) —PHI.
4. Humpton, Hand book of financial decisions —PHI.

IE14C HUMANRESOURCEMANAGEMENT

M.Tech I SEMESTER

INDUSTRIAL ENGINEERING

(Programme Elective- I)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT

UNIT-I

Introduction: Definition of personnel management, concept of labour, organisation and function of the personnel department, personnel policies.

Organisational objectives, functions, relationships, organisational structure of formal and organisations, job design.

UNIT-II

Man power planning: Man power forecasting, mobility and promotion problems, job analysis and job description.

Selection: Developing sources, methods of recruitment, alternative selection policies, application blanks and qualification card, interviews, psychological testing.

UNIT-III

Training: The nature of training, objectives in training, types of training, requirements of effective trainingconventionaltrainingtechniques,grouptraining,organisationdevelopment,evaluatingtraining effectiveness.

Performanceappraisal: Traditional performance appraisal systems, appraisal programs.

UNIT-IV

Wage and Salary Administration: Factors affecting compensation policy – equity and compensation -comparable value, job evaluation, job evaluating systems- simple ranking- job grading-point systems factor comparison system ,effects of job evaluation on human relations, Expectancy theory and compensation, variable compensation, supplementary compensations.

UNIT-

Human Factor Management: Human factors in management behavioural models, motivation, Maslow's hierarchy of needs theory-hygiene approach to motivation, expectancy theory, reinforcement theory McClelland's needs theory, motivational techniques.

Leadership: Definition, trait approaches to leadership, leadership behaviour and styles, situational approach to leadership.

Communication and Counselling: Nature and importance of communications, channels and structure, communication process, Management by objectives, counselling.

COURSE OUTCOMES:

At the end of the course student will be able to

1. Understand concepts of personnel management and organisational structure of formal and organisations identify the importance of human resources.
2. Understand different tools used in planning of human resource needs and select suitable personnel.
3. Understand the effective training techniques and performance appraisal systems for organisational development
4. Establish and maintain an equitable wage and salary system using Wage and salary administration concepts.
5. Understand the concepts of Human factors in management behavioural models, leadership behaviour and importance of communications

REFERENCES

1. Scott, Clothier, Springel, Personnel Management, McGraw-Hill
2. Strauss and Sayles Personnel, The Human Problems of Management, Prentice Hall.
3. Edwon,B. Fillipo, Personnel Management
4. Koontz, O.Donnel, Weihreich, Essentials of Management, McGraw-Hill.
5. Kapoor, N.D., Introduction to Commercial & Industrial Law, Sultan Chand &Sons.

IE14C EXPERTSYSTEMSIN MANUFACTURING
M. Tech I SEMESTER
Common to Industrial Engineering & Production Engineering

(Programme Elective- I)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Artificial Intelligence & Expert Systems, (Knowledge based systems); Definition —— Justification —— Structure Knowledge acquisition; Knowledge base, Inference engine, User interface, Explanatory module, Forward and backward chaining

UNIT-II

Knowledge representation and inferencing. Building expert systems Suitability of task, architecture, hardware, software, personnel- Expert system building tools language, shells.

UNIT-III

Commercial software for manufacturing applications in CAD, CAPP, MRP, CAM, MRP II, Adaptive control of devices, Robotics, Process control, Fault diagnosis, Failure analysis etc.;

UNIT-IV

Linking expert systems to other software such as DBMS, MIS, MDB, Process control and office- automation.

UNIT-V

Case studies of typical applications in process planning, tool selection, cutting toolselection, part classification, inventory control, facilities planning, etc.

Course Outcomes:

At the end of the course student will be able to

1. Understand the Knowledge based systems in solving real-time problems.
2. Develop the expert systems
3. Apply expert system software for manufacturing applications
4. Link the expert systems to other software.
5. Solve the problems in the field of machining, inventory control, process planning with the help of expertsystems.

REFERENCES

1. Adodji.B, BAd1I.N Expert System Applications in Engineering & Manufacturing —— John Wiley & Sons (l995)
2. Peter Jackson Introduction to Expert Systems. MartinMerryExpertSystem—85

IE15C DESIGNFORMANUFACTURING
M. Tech I SEMESTER
Common to Industrial Engineering & Production Engineering

(Programme Elective- II)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Introduction: Design philosophy-steps in design process-general design rules for manufacturability-basic principles of designing for economical production- creativity in design.

Machining processes: Overview of various machining processes-general design rules for machining- dimensional tolerance and surface roughness-Design for machining- ease – redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

UNIT-II

Metal casting: Appraisal of various casting processes, selection of casting process- general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting.

UNIT-III

Metal joining: Appraisal of various welding processes, factors in design of welding – general design guidelines- pre and post treatment of welds-effects of thermal stresses in weld joints-design of brazed joints. Forging: Design factors for forging–closed die forging design — parting lines of dies — drop forging die design — general design recommendations.

UNIT-IV

Extrusion & Sheet metal work: Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

UNIT-V

Plastics: Viscous elastic and creep behaviour in plastics-design guidelines for plastic components-design considerations for injection moulding – design guidelines for machining and joining of plastics.

COURSEOUTCOMES:

1. Design components for machining
2. Simulate the casting design and choose the best casting process for a specific product.
3. Evaluate the effect of thermal stresses in weld joints
4. Design components for sheet metal work by understanding in depth the sheet metal processes and their formation mechanisms
5. Design plastic components form machining and joining and selecting a proper processes for different joining cases

REFERENCES:

1. Design for manufacture,Johncobert,AdissonWesley.1995
2. Design for Manufacture by Boothroyd,
3. Design for manufacture, James Bralla
4. ASMHandbookVol.20

IE15C MARKETINGMANAGEMENT
M.Tech I SEMESTER
INDUSTRIAL ENGINEERING
(Programme Elective- II)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Introduction: Marketing System, role of scientific marketing analysis. Marketing models, their uses and limitations.

UNIT-II

Product Decisions: How to introduce new product**-** the generation of product idea, product research, developing utility measures for product research. Product evaluation (Break**-** even analysis). Product development (application of PERT/CPM).

Purchasing Decisions: Purchasing under fluctuating prices purchasing with quantity discounts. Pricing

UNIT-III

Decisions: Objectives in setting market price and the policies adopted in setting market price for a certain product. Strategic pricing analysis (Decision trees in pricing analysis).

UNIT-IV

Advertising Decisions: Sales response to advertising, joint optimization of price advertising and quality, Game theory models in advertising. Media advertising allocation model.

UNIT-V

Promotional Decisions: Spatial allocation of selling expenses, sales men recruitment and selection, application of dynamic programming to promotional effort, Branch-switching analysis.

Distribution Decisions: Distribution Systems, Ware housing problems.

COURSEOUTCOMES:

1. State the role and functions of marketing within a range of organizations.
2. Describe key marketing concepts, theories and techniques for analysing a variety of marketing situations.
3. Use written formats to communicate marketing outcomes.
4. Apply the introduced conceptual frame works, theory and techniques to various marketing contexts.
5. Synthesise ideas into a marketing plan.

REFERENCES:

1. Phillips Kotler, Marketing Management Analysis, Planning & Control.
2. Phillips Kotler, Marketing Management—A Model Building Approach.
3. King, Analytical Methods in Marketing.
4. Station, Fundamentals of Marketing.
5. Montgomery, Management Science applied to Marketing.

IE15C SYSTEMDYNAMICS
M.Tech I SEMESTER
INDUSTRIAL ENGINEERING
(Programme Elective- II)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Mental models for traditional management their strengths and weaknesses; Synthesizing concept of traditional management, feedback control, and computer simulation.

UNIT-II

Physical and information flows Causality and its interpretation- Causal loop diagrams and flow diagrams- Decisions and Policies- Level and rate configurations- Principles of modelling- Behavioural characteristics of low order systems.

UNIT-III

Smoothing of information- Exponential delays- Response characteristics of smoothing and delay functions. Simulation of system dynamics models

UNIT-IV

Some applications of system dynamics methodology to policy design problems in industrial economic social, environmental, and technological systems, etc.

UNIT-V

Comparison of system dynamics with popular social science modelling paradigms such as operations research economics and cross- impact theory.

COURSEOUTCOMES:

1. Understand mental models for traditional management and synthesizing concept of traditional management.
2. Able to develop Causal loop diagrams and flow diagrams
3. Analyse the Response characteristics of smoothing and delay functions
4. Apply the system dynamics methodology to policy design problems
5. Able to compare the system dynamics popular social science modelling paradigms.

REFERENCES:

1. Coyle, RG. Management System Dynamics.
2. Forrester, J.W., Industrial Dynamics.
3. Forrester, J.W., Principles of System.
4. Goodman, M.R, Study Notes on System Dynamics.
5. Richardson, G.P. and Pugh, A. L., Introduction to System Dynamics Modelling with DYNAMO.
6. Roberts, E.B., Managerial Applications of System Dynamics.
7. Roberts, N. etal., Introduction to Computer Simulation—The System Dynamics Approach.
8. Mohapatra, P.K.J.,P. Mandal, and Bora, M.C., Lecture Notes on System Dynamics.
9. System Dynamics An International Journal of Policy Modelling, System Dynamics Society of India.
10. System Dynamics Review, System Dynamics Society, M.I.T.

IE15C ENTERPRISE RESOURCE PLANNING
M.Tech I SEMESTER
Common to Industrial Engineering & Production Engineering
(Programme Elective- II)
Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Introduction to ERP: Enterprise – An Overview, Integrated Management Information, Business Modelling, Integrated Data Model

UNIT-II

ERP and Related Technologies Business Processing Reengineering (BPR), Data Warehousing, Data Mining, On-line Analytical Processing (OLAP), Supply Chain Management (SCM), Customer Relationship Management (CRM), MIS - Management Information System, DSS - Decision Support System, EIS - Executive Information System.

UNIT-III

ERP Manufacturing Prospective: MRP - Material Requirement Planning, BOM - Bill of Material, MRP - Manufacturing Resource Planning, DRP - Distributed Requirement Planning, PDM - Product Data Management

UNIT-IV

ERP Modules Finance, Plant Maintenance, Quality Management, Materials Management

UNIT-V

Benefits of ERP Reduction of Lead-Time, On-time Shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Design-making Capability

COURSE OUTCOMES:
At the end of the course student will be able

1. To understand the basic concept of enterprise resource planning (ERP).
2. To analyse the related technologies of business processing reengineering.
3. To apply the concept of MRP 1, MRP 2, BOM, DRP and PDM.
4. To develop the ERP models.
5. To understand the ERP reduction of timings and benefits.

REFERENCE:

1. Enterprise Resource Planning - Alexis Leon, Tata McGraw Hill.
2. Enterprise Resource Planning – Diversified by Alexis Leon, TMH.
3. Enterprise Resource Planning - Ravi Shankar & S. Jaiswal ,Galgoti

IE16L INDUSTRIAL LAB – I
M.TECH I SEMESTER
INDUSTRIAL ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 0-0-3-1.5

COURSE CONTENT:

LISTOF EXPERIMENTS:

1. Draw two handed process charts for Bolt, Washer & Nut assembly.
2. Performance rating
3. Standard time calculation.
4. Development of OC curves.
5. Pin board study.
6. Inventory control system.
7. Productivity measurement
8. Ergonomic design
9. Random number generation

COURSE OUTCOMES:

1. To develop two handed process charts for Bolt, Washer & Nut assembly.
2. To evaluate performance rating and standard time.
3. To develop OC curves for a sampling study.
4. To understand and analyse the inventory control systems, and random number generation
5. To understand the concept of productivity measurement and ergonomic design.

IE17L SIMULATION LAB – I
M.TECH I SEMESTER
INDUSTRIAL ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 0-0-3-3

COURSE CONTENT:

LISTOF EXPERIMENTS:

1. Simplex Method
2. Two Phase Method
3. Big M-Method.
4. Transportation Model
5. Queuing Model
6. Sequencing model
7. Assignment model
8. P-system, Q-system Inventory Models
9. PERT
10. Make or buy decision

COURSE OUTCOMES:

At the end of the course student will be able to

1. To apply the simplex, big M, two-phase methods.
2. To simulate the transportation model, queuing model, sequencing model.
3. To solve P-system, Q-system optimization problems.
4. To apply the PERT for a project duration estimation
5. To solve make or buy decision problems.

IE18C RESEARCH METHODOLOGY AND IPR
M.Tech I SEMESTER
INDUSTRIAL ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT-II

Effective literature studies approaches, analysis, Plagiarism, Research ethics.

UNIT-III

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT-IV

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT. Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT-V

New Developments in IPR: Administration of Patent System. New developments in IPR, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

COURSE OUTCOMES:

At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyse research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

REFERENCES:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & Engineering students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

IE21C ADVANCED OPERATION RESEARCH
M.Tech I SEMESTER
INDUSTRIAL ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 3-1-0-4

COURSE CONTENT:

UNIT-I

Non - linear Programming: Classical Optimisation techniques and Kuhn Tucker theory — One dimensional minimization — Unconstrained and Constrained minimisation methods – Quadratic programming.

UNIT-II

Stochastic programming — Geometric programming problem and applications.

UNIT-III

Dynamic Programming: Characteristics of dynamic programming problems — single and multi — stage models — Practical applications to inventory and Cargo loading problems.

UNIT-IV

Multi — criteria Optimization: Introduction to multi criteria optimization — Methods of solution. Goal programming and applications.

UNIT-V

Meta Hemistich — genetic Algorithms, Simulated Annealing, Tabu search, Ant Colony Optimization algorithms.

COURSE OUTCOMES:

At the end of the course student will be able

1. To solve classical optimization problems
2. To apply stochastic programming and geometric programming concepts for solving of problems.
3. To solve constrained and Unconstrained and cargo loading problems by dynamic programming.
4. To apply multi criteria and goal programming for different applications.
5. To understand and apply heuristic algorithms for solving of problems.

REFERENCES:

1. Taha, Hamdy. A., Operations Research an Introduction. PHI Edition, 6th Edition.
2. Rao, S.S., Optimisation theory and practice — PHI.
3. Hiller & Liberaman, Operations Research — Tata McGrawhill,7t Edition,2002.

IE22CQUALITY CONTROL AND RELIABILITY
M.TECH I SEMESTER
INDUSTRIAL ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 3-1-0-4

COURSE CONTENT:

UNIT-1

Basic Concepts: Definitions of quality, Quality of design, Quality of conformance, and Quality of performance, Dimensions of quality, Quality characteristics, Quality control, Statistical quality control and cost of quality.

Fundamentals of Probability and Statistics: Events, Sample space, Probability rules, Dependent and Independent events, Statistical tools in quality control, Concept of variation, Graphical tools for data representation and analysis, Discrete and continuous probability distributions and their applications in quality control, numerical problems

UNIT-2

Control charts for Variables: Variation, Causes of variation, Objectives of control charts, Choice of variable, Subgroup size and sub grouping, frequency of sampling, control limits. Process capability analysis, Relationship of a process in control to specification limits, Variable charts - X bar chart, R chart, σ chart, revision of control limits and RPI, Introduction to custom chart and moving range charts, numerical problems.

UNIT-3

Control charts for Attributes: Control charts for fraction nonconforming (p chart, np chart) and nonconformities (c chart and u chart) with variable and constant sample size, Choice between variables and attributes control charts, revision of control limits, numerical problems.

Failure Data Analysis : Introduction, Failure Data, Quantitative measures, MTTF, MTBF, Bathtub Curve, Mean Life, Life Testing, numerical problems, Introduction to Failure Mode and Effect Analysis.

UNIT-4

Acceptance Sampling: Fundamentals of acceptance sampling, Sampling methods, OC Curves and their characteristics, AQL, IQL, LTPD, AOQ/AOQL. Types of acceptance sampling-Single, Double, Multiple, and Sequential sampling plans, Average Total Inspection, comparison amongst sampling plans, numerical problems

UNIT-5

System Reliability: Definition, Series, parallel and mixed configuration, Block diagram concept, r-out-of-n structure solving problems using mathematical models. Difficulty in achieving reliability, Methods for improving reliability during design, Different techniques available to improve reliability, Reliability-Cost trade off, Prediction and Analysis, numerical problems.

Maintainability and Availability: Introduction, Techniques available to improve maintainability and availability, trade-off among reliability, maintainability and availability, Simple problems

COURSE OUTCOMES:

At the end of the course student will be able to

1. To understand basic concepts of quality control.
2. To apply the control charts of variables (X bar ,P bar charts) for different applications.
3. To apply the control charts of attributes (C bar ,N bar charts) and **conduct Failure Analysis**
4. To apply acceptance sampling plans for quality control.
5. Understand the concepts of reliability management, and **Maintainability and Availability:**

REFERENCES:

1. Fergenbaum, V. Armand, Total Quality Control — Tata MeGrawhill(40th Edition)
2. Besterfield H. Dale., Quality Control — A practical approach — Pearson Education Asia (2nd Edition).
3. Grant, E. L., Statistical Quality Control — Tata Mc Grawhill (6th Edition)
4. Montgomary — Statistical Quality Control — John Wiley & Sons
5. Srinath, L.S., Concepts in Reliability Engineering — Prentice Hall India.

IE23C SUPPLY CHAIN MANAGEMENT
M.TECH II SEMESTER
INDUSTRIAL ENGINEERING
(Programme Elective Course – III)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I
Development of SCM concepts and Definitions – key decision areas – strategic. Supply Chain Management and Key components, External Drivers of Change. Dimensions of Logistics – The Macro perspective and the macro dimension – Logistic system analysis.

UNIT-II
Sourcing strategy: Manufacturing management – make or buy decision – capacity management – Materials Management – choice of sources – procurement planning.

UNIT-III
Distribution strategy: Choice of Market – network design – warehouse designed operation and distribution planning – transportation – packaging.

UNIT-IV
Inventory Strategy: Demand forecasting – inventory planning – planning of stocking facilities – warehouse location allocation. Warehouse design and operations – inventory norms.

UNIT-V
Channels of Distribution – Customer Service Strategy: Identification of Service needs, cost of services – revenue Management.

COURSE OUTCOMES:
At the end of the course student will be able to learn the

1. To understand the concept of SCM and Logistic system analysis.
2. To apply the concepts of manufacturing management and materials management.
3. To develop distribution strategies for market choices warehouses.
4. To develop inventory strategies
5. To understand the channels of distribution.

REFERENCES:

1. Supply Chain Management Strategy, Planning and operation — Sunil Chopra and Peter Meindl.
2. Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies by David Simchi-Levi, Philip Kaminsky and Edith Simchi-Levi
3. Supply Chain Management: Strategy, Planning, and Operation by Sunil Chopra and Peter Meindl 4. Supply Chain Logistics Management by Donald Bowersox, David Closs and M. Bixby Cooper
4. The Handbook of Logistics and Distribution Management: Understanding the Supply Chain by Alan Rushton, Phil Croucher and Peter Baker

IE23C SYSTEM SIMULATION
M.TECH II SEMESTER
INDUSTRIAL ENGINEERING
(Programme Elective Course – III)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I
Modelling: Discrete- event and process representations, High- level and low- level languages.

UNIT-II
Input Modelling: fitting distributions to data, selecting distributions without data, non stationary arrival processes, multi variate input models.

UNIT-III
Output Analysis: point and interval estimation for means, probabilities and quintiles.

UNIT-IV
Experiment Design: terminating vs. steady-state simulation, determining number of reps/batches for fixed precision, initial bias mitigation, use of common random numbers and antithetic variates.

UNIT-V
Variety Generation: pseudorandom number generators, inverse cdf transformation, non stationary arrival processes, multivariate input models Using Simulation in Research: experiment within an experiment approach

COURSE OUTCOMES:
At the end of the course student will be able to
1. To understand about the modelling and types of modelling languages.
2. To develop models with multi variety inputs
3. To perform output analysis.
4. To create the experiments designs.
5. To generate random numbers for Simulation

REFERENCES:

1. J. Banks, J. S. Carson, B. L. Nelson and D. M. Nicol (2001), Discrete Event System Simulation, 3rd Ed., Pearson Education International Series.
2. A. M. Law and W. D. Kelton (2000), Simulation Modeling and Analysis, 3rd Ed., McGraw Hill International - Industrial Engg. Series.

IE23C PROJECT MANAGEMENT
M.TECH II SEMESTER
INDUSTRIAL ENGINEERING
(Programme Elective Course – III)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Basics of Project Management: Introduction, Need for Project Management, Project Management Knowledge Areas and Processes, The Project Life Cycle, The Project Manager (PM), Phases of Project Management Life Cycle, Project Management Processes, Impact of Delays in Project Completions, Essentials of Project Management Philosophy, Project Management Principles

UNIT-II

Project Identification and Selection: Introduction, Project Identification Process, Project Initiation, Pre-Feasibility Study, Feasibility Studies, Project Break-even point

Project Planning: Introduction, Project Planning, Need of Project Planning, Project Life Cycle, Roles, Responsibility and Team Work, Project Planning Process, Work Break down Structure (WBS)

UNIT-III

Organisational Structure and Organisational Issues: Introduction, Concept of Organisational Structure, Roles and Responsibilities of Project Leader, Relationship between Project Manager and Line Manager, Leadership Styles for Project Managers, Conflict Resolution, Team Management and Diversity Management, Change management

UNIT-IV

Project Performance Measurement and Evaluation: Introduction, Performance Measurement, Productivity, Project Performance Evaluation, Benefits and Challenges of Performance Measurement and Evaluation, Controlling the Projects

UNIT-V

Project Execution and Control: Introduction, Project Execution, Project Control Process, Purpose of Project Execution and Control

COURSE OUT COMES:

At the end of the course, students will be able to

1. Understand the project principles and project life cycles as to avoid the project delays and the design stage itself to arrive at the Break-even point
2. Analysis the project planning, the role and responsibility of the team work in the assignment of jobs
3. understand the Organization structure, responsibilities and role of leaders and team management
4. Analyse the Process of Implementation of Performance Measurements For Better Productivity And Project Process Control
5. Execute And Control Of Projects

REFERENCES:

1. Effective project management by Robert K.Wysoki

IE15C INTELLIGENT MANUFACTURING SYSTEMS
M TECH I SEMESTER
INDUSTRIAL ENGINEERING
(Programme Elective- II)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT I:
Computer integrated manufacturing systems – structure and functional areas of CIM system - AD, CAPP, CAM, CAQC, ASRS and advantages of CIM Manufacturing communication systems – MAP/TOP OSI model, data redundancy, top-down and bottom-up approach, volume of information. Intelligent manufacturing – system components, system architecture and data flow, system operation.

UNIT II:
Components of knowledge-based systems – basic components of knowledge based systems, knowledge representation, comparison of knowledge representation schemes, interference engine, knowledge acquisition Machine learning – concept of artificial intelligence, conceptual learning, and artificial neural networks -biological neuron, artificial neuron, types of neural networks, applications in manufacturing.

UNIT III:
Automated process planning – variant approach, generative approach, expert systems for process planning, feature recognition, phases of process planning knowledge Based System for Equipment Selection (KBSES) – Manufacturing system design, equipment selection problem, modelling the manufacturing equipment selection problem, problem solving approach in KBSES, structure of the KBSES.

UNIT IV:
Group technology: models and algorithms – visual method, coding method, cluster analysis method, matrix formation – similarity coefficient method, sorting-based algorithms, bond energy algorithm, cost-based method, cluster identification method, extended ci method.

UNIT V:
Knowledge-based group technology - group technology in the automated manufacturing system, structure of knowledge-based system for group technology (KBSGT) – data base, knowledge base, clustering algorithm.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Describe the performance of manufacturing systems.
2. Derive the systemic approach for designing and implementing manufacturing systems.
3. Analyze new procedures to improve productivity and existing manufacturing systems.
4. Explain and Analyze online collaboration tools to work in complex teams
5. Understand the group technology in automated manufacturing systems.

REFERENCES:

1. Andre Kusaic, "Intelligent Manufacturing Systems" , PHI, 1989.
2. Hamid R.Parsaei and Mohammad Jamshidi,"Design and Implementation of Intelligent Manufacturing Systems" , PHI, 2009.
3. Mikell P Groover, "Automation, Production Systems and Computer Integrated Manufacturing", 8th edition, PHI, 2008.
4. YagnaNarayana, "Artificial neural networks" , PHI,2009.

IE24C PRODUCTIVITYENGINEERINGMANAGEMENT
M.TECH II SEMESTER
(Programme Elective Course – III)
Common to Industrial Engineering & Production Engineering

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Basic definitions and Scope-Significance of Productivity in economic development. Productivity measurement at nation level. Benefits of higher productivity at firm level. Diversity of productivity concepts.

UNIT-II

Productivity measurement models—Partial Productivity models, the multi—factor productivity Computers for productivity measurement. Productivity Evaluation Productivity Models, Total Model. Expression for Total Productivity change, the Productivity Evaluation Tree.

UNIT-III

Productivity Planning—Long and Short Term Productivity models Causes of flow productivity in companies — various strategies for productivity improvement. The Analytical Productivity Model.

UNIT-IV

Productivity Management at Enterprise level—Productivity Improvement Techniques—Technology based, Materials based, Product based, employee based and cost based. Productivity in service industries

UNIT-V

Case Studies, R&D Productivity, Evaluation of R&D, productivity, Technology Transfer.

COURSE OUTCOMES:

At the end of the course student will be able to learn the

1 Analyse the significance of productivity measurement at national level and firm level
2 Implement the Productivity measurement models.
3 develop Productivity Planning
4 apply Productivity Improvement Techniques
5 Carryout case studies of productivity improvement for entrepreneurship development and technology transfer

REFERENCES

1. Sumanth David, J., Productivity Engineering and Management —McGraw-Hill Book(1984)
2. Scott, Sink, D., Productivity Management Planning, Measurement and evaluation, control and Improvement.

IE24C LOGISTICS ENGINEERING & MANAGEMENT
M.TECH II SEMESTER
INDUSTRIAL ENGINEERING
(Programme Elective Course – III)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Logistics: Nature & Concepts – Evolution – Importance – Advantage – Objectives – Components – Functions – Supply Chain Management: Nature & Concepts – Value chain – Functions & Contribution – Effectiveness – Framework – Outsourcing – 3 PLs – 4 PLs – Bull whip effect – SC Relationships – Conflict resolution – Harmonious relationship – Customer Service: Nature & Concepts – Importance – Components – Cost – Gap analysis – Strategic management – Case Study.

UNIT-II

Information: Position of Information in L&SCM – Logistical Informational Systems – Operational Logistical Informational Systems – Integrated Information Technology Solution for L&SCM – Emerging L&SCM – Demand Forecasting: Nature & Components – Impact of forecast on L&SCM – Effective forecasting – Techniques – Selection – Principles – Inventory: Concepts – Types – Functions – Elements – Inventory management – ABC analysis – ABC-VED matrix – Materials Requirement Planning – Distribution Requirement Planning – Just in Time System – Prerequisites – Case study

UNIT III

Transportation: Introduction – Position of transportation in L&SCM – Elements of transportation cost – Modes – Multimodal transport – Containerization – Selection of transportation modes – Transportation decision – Transportation network: routing & scheduling – Warehousing & Distribution Centers

UNIT IV

Protective Packaging: Introduction – Concepts – Functions – Forms – Problems – Policy – Order Processing: Introduction – Concepts – Functions – Elements – Significance – Materials Handling: Introduction – Concept – Objective- Principles – Equipments – Considerations – Purchasing & Sourcing Management: Introduction – Nature – Scope – Importance – Trends – Contemporary sourcing & supplier management – Case study.

UNIT-V

Organization: Introduction – Evolutionary trends of L&SCM – Principles – Factors.
Performance Measurement: Introduction – Dimensions – Basic tools – Impediments to improve performance – Case Study.

COURSE OUTCOMES:

At the end of the course student will be able to learn the

1. To understand the basic fundamentals of logistics nature and concepts.
2. Develop Logistical Informational Systems
3. Develop Transportation network
4. Apply the basic concept of protective packaging and material handling
5. Apply the L&SCM tools to improve performance of organisation.

REFERENCES:

1. Agrawal, D.K., "A Text book of Logistics & Supply Chain Management", MacMillan Publishers India Ltd., 2009.
2. Sunil Chopra & Peter Meindl, "Supply Chain Management, Strategy, Planning and Operation", 2 nd Edition, PHI, 2004.
3. David J. Bloomberg, Stephan Lemay & Joe B. Hanna, "Logistics", PHI, 2002.
4. Jeremy F.Shapiro, "Modeling the Supply Chain", Thomson Duxbury, 2002.
5. James B. Ayers, "Handbook of Supply Chain Management", St. Lucle Press, 2000.

IE24C SERVICE ENGINEERING & MANAGEMENT
M.TECH II SEMESTER
INDUSTRIAL ENGINEERING
(Programme Elective Course – III)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Introduction Strategic service vision, service concepts and strategy, Understanding services, focus on customers, customer service management; Design and delivery of the services, Managing capacity and demand, Service quality and productivity, Globalization of services, Service Network; IT Enabled services, Design and operation of systems for e-Business

UNIT-II

Business Process Management - process analysis, reengineering, process measurement and effectiveness

UNIT-III

Management science application in services- Applications of inventory models, location analysis, queuing theory, operations scheduling, economic analysis, decision models, utility theory, simulation modelling, performance evaluation with data envelopment analysis, AHP and productivity models, evaluation of the dynamics of enablers, inhibitors and results

UNIT-IV

Management Control systems -control processes, performance measurement, variations in management control and modern control systems, management control of projects, management control of reliability; BPO and Services marketing

UNIT-V

Applications of Technology management, Benchmarking, Customer relationship management, Data mining and Knowledge management

COURSE OUTCOMES:
At the end of the course student will be able to learn the

1. To analysis the concept of strategic service vision.
2. To create the business process management and effectiveness of measurements.
3. To apply the management science application in services.
4. To remember the management control systems with their applications.
5. To understand the concept of application of technology management.

REFERENCES:

1. James A. Fitzsimmons and Mona J. Fitzsimmons (2000(T)), Service Management: Operation, Strategy and JIT, Third Edition, McGraw-Hill, Inc, NY.
2. Joseph M. Juran (1992), Quality by Design, The Free press.
3. R. Kalakota and A. B. Whiston (1999), Frontier of Electronic Commerce,AddisonWesley.
4. R. N. Anthony and V. Govindarajan (1998), Management Control Systems, Tata McGraw Hill Publishing Co. Ltd.
5. K. D. Hoffmann and J. E. G. Bateson (2002), Essentials of Services Marketing, Thomson South Western College Publishing.
6. M. J. A. Berry and G. S. Linoff (2001), Mastering Data Mining-The Art and Science of CRM, John Wiley & Sons Inc

IE24C ENERGY MANAGEMENT
M.TECH II SEMESTER
Common to Industrial Engineering & Production Engineering
(Programme Elective Course – III)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Introduction: Principles of energy management. Managerial organization, Functional areas for i) manufacturing industry, ii) Process industry, iii) Commerce, iv) Government, Role of Energy manager in each of these organizations. Initiating, Organizing, and managing energy management programs.

UNIT-II

Energy Audit: Definition and concepts. Types of energy audits, Basic energy concepts, Resources for plant energy studies. Data gathering, Analytical techniques. Energy Conservation: Technologies for energy conservation, Design for conservation of energy materials, Energy flow networks.

UNIT-III

Alternative Energy Sources: **Solar Energy** – Types of devices for Solar Energy Collection.
Solar Energy Collection: Flat plate and concentrating collectors – Classification of concentrating collectors – Orientation and Thermal analysis – Advanced collectors.
Solar Applications: Solar heating/cooling techniques – Solar distillation and drying - Photovoltaic energy conversion.

UNIT-IV

Wind Energy: Sources and potentials – Horizontal and Vertical axis windmills – Performance characteristics.
Solar Energy Storage: Different methods – Sensible, Latent heat and Stratified storage – Solar Ponds.

UNIT-V

Bio-Mass: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of biogas, utilization for cooking.
Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India.
Ocean Energy: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles.

COURSE OUTCOMES:

At the end of the course student will be able to learn the

1. To remember the principles of energy management.
2. To analysis the energy audit.
3. To understand the basic concepts of Alternate energy sources.
4. To understand the basic concepts of alternate energy sources (wind , solar).
5. To understand the basic concepts of biomass , geothermal and ocean energies.

REFERENCES:

1. Energy Management Hand Book / W.C. Turner (Ed)
2. Rai G.D. : Non-conventionalEnergy Sources, Standard PublishersDistributors.
3. Solar Energy /Sukhatme
4. Energy Management Principles / CB Smith/ Pergamon Press
5. Energy Management / W.R.Murthy and G.Mc.Kay / BS Publication
6. Management / H.Koontz and CyrillDonnel / McGraw Hill.

IE25L INDUSTRIAL ENGINEERING LAB-II
M.TECH II SEMESTER
INDUSTRIAL ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 0-0-3-1.5

COURSE CONTENT:

LIST OF EXPERIMENTS:

1. Sales forecasting.
2. Control charts for Variables.
3. Control charts for Attributes.
4. Development of Bill of Materials for MRP.
5. Draw SIMO charts for Ball Point Pen assembly.
6. Determine cycle time using MTM
7. Draw flow process charts for Activities by taking a case study.
8. Determine percentage utilization using work sampling.

COURSE OUTCOMES:

At the end of the course student will be able to

1. Predict future demand using forecasting techniques.
2. Apply the control charts for checking allowable limits.
3. Prepare the BOM for MRP.
4. Apply the concepts of MTM, SIMO charts and work sampling.
5. Draw flow process chart and conduct work sampling study.

IE26L SIMULATION LAB – II
M.TECH II SEMESTER
INDUSTRIAL ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 0-0-3-1.5

COURSE CONTENT:

LIST OF EXPERIMENTS:

1. PERT Model
2. Transportation Model
3. Queuing Model
4. Sequencing Problem
5. Assignment Problem.
6. DOE by Taguchi design.
7. DOE by Response surface methodology.
8. Single response Optimization.
9. Multi response Optimization.
10. Layout optimization

COURSE OUTCOMES:

At the end of the course student will be able

1.To apply the PERT for a project duration estimation.
2.To simulate the transportation model, queuing model, sequencing model.
3. To develop DOE by Taguchi and Response surface methodology.
4.To solve the single and multi-response optimization problems.
5. To solve layout optimization problems.

IE27C LEADERSHIP QUALTIES FOR ENGINEERS
M.TECH II SEMESTER
INDUSTRIAL ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Introduction to Leadership Roles, functions and characteristics of a leader, evolution and growth of leadership, Leadership traits and ethics, Attitude, Behavior, Personality traits and leadership, Types and Styles of leadership, Leader vs Manager, Essential qualities of an effective leader.

UNIT-II

Leadership and Management (Nature, Scope and Significance of Management, Levels of Management, Functions: Planning, Organizing, Staffing, Directing and Controlling, Skills: Conceptual, Human and Technical, Roles: Interpersonal, Informational and Decisional, difference between a leader and a manager)

UNIT-III

Types of Leaders, Leadership styles: Traditional, Transactional, Transformational, Inspirational and servant leadership and Emerging issues in leadership: Emotional Intelligence and leadership, Trust as a factor, Gender and Leadership.

UNIT-IV

Personality: Concept and Definition, Determinants of personality, Personality traits, Personality characteristics in organizations: Self-evaluation, Locus of control, Self-efficacy, Self-esteem, Self-monitoring: Positive and negative Impact.

UNIT-V

Self-Discovery (Awareness of personal values, beliefs and vision that motivates behavior, Personal SWOT, Trust: Openness, confidentiality, blind spot and unknown part of personality, Self-disclosure, seeking feedback, self-reflection, introspection and self-management.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. To understand the leadership roles.
2. To apply the concepts of Leadership and Management.
3. To understand and apply the concepts of Leadership styles.
4. Inculcate and apply personality development aspects.
5. To inculcate and create awareness.

REFERENCES:

1. Organisational Behaviour , M.Parikh and R.Gupta , Tata McGraw Hill Education Private Limited
2. Organisational Behavior, D. Nelson, J.C Quick and P. Khandelwal, Cengage Publication.

IE27C STRESS MANAGEMENT
M.TECH II SEMESTER
INDUSTRIAL ENGINEERING
(Value Added Course)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Meaning and nature of stress: Difference between eustress and distress; Frustration, conflict and pressure; Meaning of stressors; common stressors at work place: Stressors unique to age and gender. Stress and Memory; Stress and Other Cognitive Variables; Stressful environmental conditions on performance.

UNIT-II

Behavioural aspects of Stress: Adaptive and Maladaptive Behaviour; Individual and Cultural Differences: Sources of Stress- Across the Lifespan; College and Occupational Stress.

UNIT-III

Stress and Work performance: Role of communication in managing stress and work performance: Emotional regulation and coping; Emotional intelligence and conflict management: Emotional Basis and Stress; Stress and Conflict in Relationships. Stress intervention – interpersonal, Management Standards and Management Competencies.

UNIT-IV

Strategies of Stress Management: Prevention of stress Challenging Stressful Thinking; Problem Solving; Emotional and cognitive coping styles: Strategies of Synthesis and Prevention: Resilience and Stress; Optimal functioning; Making changes last; Small changes and large rewards.

UNIT-V

Preparing for the Future: Care of the Self: Nutrition and Other Lifestyle Issues: Stress reduction practices: Time management; Exercise; Relaxation techniques; yoga; meditation.

COURSE OUTCOMES:

1. To understand the cognitive variables of stress and Learn Managing Work-Life Balance
2. Preparing for better future by reducing the stress.
3. To understand the nature and consequences of stress
4. To understand the impact of stress on work.
5. To recognize the stressors, Adaptive and Maladaptive behavior

REFERENCES:

1. Baron .L &Feist.J (2000) Health Psychology 4th edition, USA Brooks/Cole
2. Barlow, Rapee, and Perini(2014), 10 Steps to Mastering Stress: A Lifestyle Approach, USA
3. Clayton,M, (2011).Brilliant stressmanagement How to manage stress in any situation's 1st edition, Greart Britain Pearson Education
4. Cooper,C,&Palmer,S, (2000)Conquer Your Stress, London: Institute of personal development Universities Press
5. Dutta, P,K, (2010) Stress management Himalaya, Himalaya Publishing House
6. Lee, K. (2014). Reset: Make the Most of Your Stress: Your 24-7 Plan for Well-being. Universe Publishing.

IE27C UNIVERSAL HUMAN VALUES
M.TECH II SEMESTER
INDUSTRIAL ENGINEERING
(Value Added Course)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Introduction to Value Education : Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations.

UNIT-II

Harmony in the Human Being : Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.

UNIT-III

Harmony in the Family and Society: Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.

UNIT-IV

Harmony in the Nature/Existence : Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence.

UNIT-V

Implications of the Holistic Understanding – a Look at Professional Ethics : Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession.

COURSE OUTCOMES:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.

2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.

3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

REFERENCES:

1. JeevanVidya: EkParichaya, ANagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa 8. Bharat Mein Angreji Raj – PanditSunderlal.

IE28M: MINI PROJECT WITH SEMINAR

Instruction Hours/ Week: (L-T-P-C): 1-0-2-2

COURSE OUTCOMES:

At the end of this course, students will be able to

1. Apply emerging technology in processes and systems
2. Analyse the results
3. Deduct conclusions from results
4. Prepare report/document
5. Present effectively

CONTENT:

The students are required conduct experimental work/mathematical modelling/simulation on software packages etc. And collect relevant for analysis, and deduct the conclusions from results. Finally, the student should prepare the report and give seminar on project.

Semester III & IV
PE33ED and PE41D Dissertation Work

Phase–I, Phase–II and Viva-Voce

GUIDELINES FOR DISSERATION PHASE-I AND DISSERATION PHASE-II:

1. The dissertation is a yearlong activity; to be carried out and evaluated in two phases i.e. Phase–I in sem-3andPhase–II in sem-4.

2. The dissertation may be carried out in department laboratories/ industry.

3. After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives.

4. Phase–I evaluation: A committee comprising of guides of respective specialization shall assess the progress/ performance of the student based on report, presentation and Q&A. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.

5. During phase – II: Student is required to continue Phase-1 as per the schedule and thesis (combined phase-1&2) should be submitted at end of sem-4. Accomplished results/contributions/innovations should be published in reputed journals/ conferences/Patents.

6. Phase – II evaluation: Guide, committee with external examiner shall assess the progress/performance of the student based on report, presentation and Q&A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work.

COURSE OUTCOMES:

At the end of this course, students will be able to

1. Synthesize knowledge and skills previously gained and applied to anin-depth study and execution of new technical problem.
2. Select different methodologies to carry out the selected project work.
3. Deduct conclusions from results
4. Prepare report/document
5. Present effectively



SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI -517502

(AUTONOMOUS)

DEPARTMENT OF MECHANICAL ENGINEERING

(Choice Based Credit System)

R23

POST GRADUATION PROGRAM

MASTER OF TECHNOLOGY
in
PRODUCTION ENGINEERING

Scheme of Instructions and Evaluation
(With effect from the Academic Year 2023-24)

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502
DEPARTMENT OF MECHANICAL ENGINEERING-SCHEME OF INSTRUCTION- (CBCS) EFFECTIVE FROM THE ACADEMIC YEAR: 2023-2024

M.TECH (PG) SPECIALIZATION: PRODUCTION ENGINEERING

I-SEMESTER

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	PE11C	Advanced Manufacturing Processes	3	1	0	4	4	40	60	100
PCC	PE12C	Advanced Material Technology	3	1	0	4	4	40	60	100
PCC	PE13C	Additive Manufacturing	3	1	0	4	4	40	60	100
PEC	PE14C	Programme Elective- I	3	0	0	3	3	40	60	100
PEC	PE15C	Programme Elective- II	3	0	0	3	3	40	60	100
PCC	PE16L	Production Engineering Lab – I	0	0	3	3	1.5	40	60	100
PCC	PE17L	CAD Lab	0	0	3	3	1.5	40	60	100
MAC	PE18C	Research Methodology and IPR	3	0	0	3	3	40	60	100
	Total		**18**	**3**	**6**	**27**	**24**	**320**	**480**	**800**

List of Programme Elective					
Course Title	**I**	**Applied Probability and Statistics**	**Operations Planning and Control**	**Advanced Casting Technology**	**Expert Systems in Manufacturing**
	II	**Robotics**	**Design for Manufacturing**	**Enterprise Resource Planning**	**Intelligent Manufacturing Systems**

SEMESTER - II

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	PE21C	Computer Integrated Manufacturing	3	1	0	4	4	40	60	100
PCC	PE22C	Cutting Tool Design and Precision Machine Tool Design Strategies	3	1	0	4	4	40	60	100
PEC	PE23C	Programme Elective Course – III	3	0	0	3	3	40	60	100
PEC	PE24C	Programme Elective Course – IV	3	0	0	3	3	40	60	100
PCC	PE25L	Production Engineering Lab – II	0	0	3	3	1.5	40	60	100
PCC	PE26L	CAM LAB	0	0	3	3	1.5	40	60	100
VAC	PE27C	Value Added course	2	0	2	4	3	100	-	100
PCC	PE28M	Mini Project with Seminar	1	1	0	2	2	100	-	100
	Total		**15**	**3**	**8**	**26**	**22**	**440**	**360**	**800**

List of Programme Elective					
Course Title	**III**	**Automation in Manufacturing**	**Metal Forming Technology**	**Quality Control and Reliability Engineering**	**Finite Element Methods**
	IV	**Advanced Welding Processes**	**Oil Hydraulics and Pneumatics**	**Productivity Engineering & Management**	**Energy Management**

Value Added course	I	**II**	**III**
Course Title	**Leadership Qualities For Engineers**	**Stress Management**	**Universal Human Values**

III-SEMESTER

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
OEC	PE31C	Open Elective Course (MOOCs)	0	0	0	0	3	100	-	100
PCC	PE32I	Industrial/ Research Internship (Min of 4 Weeks)	0	0	0	0	3	100	-	100
PCC	PE33D	**Dissertation Work Phase-I**	0	0	24	24	12	40	60	100
	Total		**0**	**0**	**20**	**20**	**18**	**240**	**60**	**300**

IV-SEMESTER

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	PE41D	**Dissertation WorkPhase-II and Viva-Voce**	0	0	20	20	10 + 06 = 16	40	60	100
	Total		**0**	**0**	**20**	**20**	**16**	**40**	**60**	**100**

PE11C ADVANCED MANUFACTURING PROCESSES
M.TECH I SEMESTER
PRODUCTION ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 3-1-0-4

COURSE CONTENT:

UNIT - I

Abrasive jet machining: Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent developments.

Ultrasonic machining: Elements of the process, machining parameters, the effect of parameters on surface finish and metal removal rate, mechanics of metal removal process parameters, economic considerations, applications, and limitations.

UNIT - II

Electrochemical Processes: Fundamentals of electrochemical machining, metal removal rate in ECM, Tool design, Surface finish, and accuracy economics aspects of ECM.

Wire EDM Process: General Principles and applications of Wire EDM, Mechanics of metal removal, Process parameters, and selection of tool electrode and dielectric fluids, methods of surface finish, and machining accuracy.

UNIT - III

Electron Beam Machining: Generation and control of electron beam for machining, theory of electron beam machining, Principle, advantages, and limitations, comparison of thermal and non-thermal processes.

Plasma Arc Machining: Principle, machining parameters, the effect of machining parameters on surface finish and metal removal rate, applications, limitations

UNIT - IV

Laser Beam Machining: Principle, the effect of machining parameters on surface finish, applications, and limitations.

Surface Processing Operations: Plating and Related Processes, Conversion Coatings, Physical Vapor Deposition, Chemical Vapour Deposition, Organic Coatings, Porcelain Enamelling and other Ceramic coatings, Thermal and Mechanical Coating Processes.

UNIT - V

Processing of Ceramics: Applications, characteristics, Classification. Processing of particulate ceramics, Powder preparations, consolidation, drying, sintering, hot compaction, area of application, and finishing of ceramics. Processing of Composites: Composite Layers, Particulate and fiber-reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, and Polymer matrix composites.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Understand the Abrasive jet and ultrasonic machining process, applications, recent development, and limitations.
2. Analyze the influence of process parameters on the out responses of electrochemical and wire EDM processes.
3. Explain the Electron Beam and Plasma Arc machining with their principles, applications, and limitations.
4. Know the laser beam application for machining and understand the various surface process operations.
5. Understand and apply the various processing techniques to fabricate ceramic materials and composites for different applications.

REFERENCES:

1. Fundamentals of Modern Manufacturing- Mikell P. Groover, John Wiley & Sons Publishers
2. Modern Machining Process-P.C Pandey and H.S Shan, Tata McGraw - Hill Education (1980)
3. Manufacturing Engineering and Technology – Serope Kalpakjian & Stephen Schmid
4. Advanced Machining Processes / V.K. Jain / Allied Publications.
5. Introduction to Manufacturing Processes / John A Schey *I* Mc Graw Hill.
6. Process and Materials of Manufacturing / R. A. Lindburg / 1st edition, PHI 1990.

PE12C ADVANCED MATERIAL TECHNOLOGY
M.TECH I SEMESTER
PRODUCTION ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 3-1-0-4

COURSE CONTENT:

UNIT-I

Introduction of advanced materials: Principle of material for engineering applications and their manufacturability. Selection of Materials: Classification of materials, properties required in engineering materials

UNIT-II

Metallic Materials: Fundamental of metallic materials; Crystal structure of metals and alloys Strengthening mechanisms -Phase diagrams- Heat treatment processes -iron-carbon equilibrium diagrams-Advanced Steels and cast irons-Transformation hardening in steels TTT diagrams. Non-Ferrous Materials and High-Temperature Materials: Structure, physical metallurgy, manufacturability, and properties of Al, Mg, and Ti alloys.

UNIT-III

Composite Materials: Definition, Classification, Types of matrices & reinforcements, characteristics & selection, Fiber composites, laminated composites, particulate composites, pre-pregs, sandwich construction. Fabrication methods of in-situ, ex-situ, and Nano composites.

UNIT-IV

Mechanics of Composites: Introduction, Evaluation of the four elastic moduli – Rule of mixture, ultimate strengths of a unidirectional lamina. Hooke's law for different types of materials, number of elastic constants, Two – dimensional relationship of compliance & stiffness matrix. Hooke's law for two-dimensional angle lamina, engineering constants – angle lamina, Invariants, Theories of failure.

UNIT-V

Smart Materials: Introduction to smart materials. Principles, mechanisms, piezoelectric, magnetostrictive, electrostrictive, magnetorheological, electrorheological materials, smart gels. Shape memory alloys and Applications.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Understand the Principle and Classification of engineering materials and their properties
2. Elaborate the phase diagrams of metallic materials and their properties
3. Analyze the Classification of composite materials along with their characteristics
4. Derive ultimate strengths of the unidirectional lamina and theories of failures in composites
5. Explain the Principle and mechanism of smart materials and their applications

REFERENCES:

1. Composite Materials handbook - Mein Schwartz - McGraw Hill Book Company - 1984. 2. Mechanics of composite materials - Autar K. - Kaw CRC Press New York. – 1st edition, 1997.
3. Mechanics of composite materials - Rober M. Joness - McGraw Hill Kogakusha Ltd. – 2008.
4. W.D. Callister, Jr, - Material Science & Engineering Addition-Wesly Publishing Co.
5. Light Alloys: From Traditional Alloys to Nano Crystals- I.J. Polmear, Elsevier Publication.
6. Shape Memory Alloys- Corneliu Cismasiu, Sciyo Publication.
7. Smart Materials Fabrication and Materials for Micro-Electro-Mechanical Systems: Volume 276 (MRS Proceedings)" by George C Johnson and A Peter Jardine

PE13C ADDITIVE MANUFACTURING
M.TECH I SEMESTER
PRODUCTION ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 3-1-0-4

COURSE CONTENT:

UNIT-I

Introduction: Introduction to Prototyping, Traditional Prototyping Vs Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC and other related technologies, Classification of RP, Need for RP software, MIMICS, Magics, SurgiGuide, 3-matic, 3D-Doctor, Sim plant, Velocity2, VoXim, Solid View, 3DView, etc., Preparation of CAD models, Problems with STL files, STL file manipulation, RP data formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP.

UNIT-II

Rapid Prototyping (RP) Processes: Photo polymerization RP Processes: Stereo lithography (SL), SL resin curing process, SL scan patterns, Micro stereo lithography, Applications of Photo polymerization Processes.

Powder Bed Fusion RP Processes: Stereo lithography (SL), SL resin curing process, SL scan patterns, Micro stereo lithography, Applications of Photo polymerization Processes.
Extrusion-Based RP Processes: Fused Deposition Modelling (FDM), Principles, Plotting and path control, Applications of Extrusion-Based Processes.
Printing RP Processes: 3D printing (3DP), Research achievements in printing deposition, technical challenges in printing, Printing process modeling, Applications of Printing Processes.
Sheet Lamination RP Processes: Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications.
Beam Deposition RP Processes: Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Processing-structure-properties, relationships, Benefits and drawbacks

UNIT-III

Rapid tooling: Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct, and Indirect Tooling Methods, Soft and Hard Tooling methods

UNIT-IV

Reverse engineering: Reverse Engineering (RE) Methodologies and Techniques, Selection of RE systems, RE software, RE hardware, RE in product development

UNIT-V

Errors in RP processes and applications: Pre-processing, processing, post-processing errors, Part building errors in SLA, SLS, etc., Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Understand the prototyping, TP vs. RP, RP classification, RP needs and solid view 3D view, and preparation of CAD models.
2. Describe Rapid Prototyping (RP) Processes with their principles, applications, Processing-structure-properties, relationships, Benefits, and drawbacks.
3. Select the rapid tooling methods with Soft and Hard Tooling methods
4. Understand the Reverse Engineering (RE) Methodologies and Techniques.
5. Analyze errors in RP processes and analyze applications of RP in the medical field.

REFERENCES:

1. Chua Chee Kai., Leong Kah Fai., Chu Sing Lim, Rapid Prototyping: Principles and Applications in Manufacturing, World Scientific, 2010.
2. Ian Gibson., David W Rosen., Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010.
3. Rafiq Noorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, 2006.
4. D. T. Pham, S. S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer, 2011

PE14C APPLIED PROBABILITY AND STATISTICS
M.TECH I SEMESTER
COMMON TO INDUSTRIAL ENGINEERING & PRODUCTION ENGINEERING
(Programme Elective- I)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Introduction to Probability: Probability, sample space — axioms of probability, Random variables — Discrete and Continuous — Expectations — Moment Generating functions. Conditional probability — Bayer's theorem — Independent Events.

UNIT-II

Discrete Distributions: Binomial, Hyper geometric, Gama, Students t,Chisquare, Weibell distributions. Bivariate random variables and their distributions (with specific reference to bivariate normal distributions only). Conditional distributions — Covariance, Correlation coefficient — Regression of the mean.

UNIT-III

Functions of Random Variables: Probability distribution of functions of random variables their joint probability distribution.

Sampling: Sampling Distribution — Law of Large Numbers — Central Limit theorem.

UNIT-IV

Estimation: Point Estimation, Interval Estimation, and Confidence Intervals. (Maximum Likelihood Estimation), Bayesians Estimation.

Testing of Hypothesis: Simple hypothesis and the Neyman — Pearson lemma — Composite hypothesis — goodness of fit tests.

UNIT-V

Analysis of Variance: One way classification — Randomized, complete block designs.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Understand the basic concept of probability.
2. Explain random variables for discrete and continuous probability estimation.
3. Define sampling theory, apply it to predict the event, and analyze the statistical distributions.
4. Analyse different Estimations and Testing of hypothesis
5. Apply the concepts of analysis of variance for the Correlation between the observed and experimental values.

REFERENCES

1. Ian F. Blake, An introduction to Applied Probability — John Wiley & Sons(1979)
2. Milton, J.S., Arnold, Jee C., Probability and Statistics in the Engineering and Computing Sciences — Mc Grawhill, 2003.

PE14C OPERATIONS PLANNING AND CONTROL
M.TECH I SEMESTER
COMMON TO INDUSTRIAL ENGINEERING & PRODUCTION ENGINEERING
(Programme Elective- I)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I
OPC is a system approach—types of production and OPC functions.
Forecasting: Forecasting Methods — Qualitative Methods — Quantitative methods— moving average and exponential smoothing methods for different data patterns. Forecast errors, Tracking signal.

UNIT-II
Mass Production Management Principles of flow lines, Assembly line balancing; approach to line balancing — RPW, COMSOAL, Integer, and Dynamic programming formulations. Introduction to transfer lines.

Production Planning Linear programming formulations for static demand cases, Product Mix Decisions. Chance- constrained programming models.

UNIT-III
Aggregate Production Planning Production planning under dynamic conditions strategies, costs involved, Heuristic methods, linear production, and inventory programs. Aggregate production planning — HMMS model, search decision, parametric production planning, management coefficient models. Disaggregation- hierarchical planning, mathematical programming formulations. Master Production Schedule.

UNIT-IV
Operations Scheduling Flow shop sequencing and job scheduling. Periodic review models. Continuous review models, lot size models with dynamic demand, and inventory models of spare parts.

UNIT-V
Materials Requirement Planning (MRP): Introduction. Inventory in a manufacturing environment. Principles of MRP, MRP processing logic. MRP systems, and MRP — II, Jut-In-Time manufacturing: set-up reduction, stable MPS, and Kanban control.

COURSE OUTCOMES:

From this course, students will be able to

1. Describe Forecasting principles and techniques for short-range and long-range planning
2. Analyze Production requirements for each product and plan the shop floor activities
3. Elaborate Work station loading and scheduling of paths to avoid bottlenecks for smooth production
4. Design Solution for product mix decision using OR techniques.
5. Analyse Optimal job sequences to achieve the minimum makespan with maximum production

REFERENCES

1. Montgomery, Operations Research in Production Planning, Scheduling and Inventory Control — Prentice Hall, N.J
2. Buffa, E.S., Operations Management — John Wiley & Sons.
3. Elsyod and Boucher Analysis of Production Systems, Prentice Hall, N.J,ISE Series
4. Burbridge, Production Planning — Heinemann Publishers, 1971.

PE14C ADVANCED CASTING TECHNOLOGY
M TECH I SEMESTER
PRODUCTION ENGINEERING
(Programme Elective- I)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Moulding Materials Sand — Silica, Zircon, Chromite, Olivine sands; Binders —Bentonite, cement, sodium silicate, Ethyl silicate, plaster of Paris, carbohydrates, setting oils, synthetic resins; Additives — Coal dust, wood flour, silica flour; Mould and core coatings; Moulds auxiliary materials; Parting agents, core paste, exothermic, insulating sleeve materials; Sand testing and controls.

UNIT-II

Furnaces Design features of Arc and Induction furnaces, heat treatment furnaces including salt bath furnaces and induction heating

UNIT-III

Principles of Casting Design Basic concepts of Engg. Analysis of metal fabrication with particular reference to casting processes. Factors influencing the production of engg., castings to customers' specifications, attempt making. Chvorinov's rule, design of running and feeding systems; factors affecting the engineering design of castings. Functional design, freezing range alloys in metallic and non—metallic moulds, grain refinement, modification, various types of defects in non—ferrous alloys, influence of form and environment.

UNIT-IV

Non-ferrous foundry metallurgy Properties of liquid metals, their significance in foundry practice, oxidation, solution of gases in metals, fluidity, hot tear, shrinkage and solidification Mechanisms of pure metals, Eutectic and long range freezing alloys — some advances in die casting including Acurad process — some features of steel foundry practice, specification of moulding material, Foundry practice of non-ferrous metals and alloys.

UNIT-V

Foundry Mechanization and management General principles and objectives, Plant layout Mechanization foundries, selection of equipment, operation and flow process charts.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Identify materials for moulding, additives, coating, and the methods of sand controls.
2. Analyze different furnaces for metal melting and design a suitable furnace depending on materials.
3. Explain the concepts related to the casting processes and the factors influencing the design process for metals and alloys.
4. Describe the properties of liquid metals and their compositions and attain the various alloys depending upon the temperature, Iron-carbon diagram.
5. Understand the principles of mechanization of foundries with their layouts and purchase of suitable plant layouts.

REFERENCES

1. Rosenthal et al., Principles of Metal Casting — Tata Mc Grawhill Publishers.
2. Ruddle Riser and Gating design
3. Murphy Non — ferrous Foundry Metallurgy
4. Tompkins and White Facilities planning — John Wiley & Sons.
5. Flinn Metal Casting — Prentice Hall India.
6. P. L. Jam Principles of Metal Casting — Tata McGraw-Hill
7. O. P. Khanna Foundry Technology — Khanna Publishers.

PE14C EXPERTSYSTEMSIN MANUFACTURING

M. Tech I SEMESTER

Common to Industrial Engineering & Production Engineering

(Programme Elective- I)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Artificial Intelligence & Expert Systems, (Knowledge based systems); Definition — Justification — Structure Knowledge acquisition; Knowledge base, Inference engine, User interface, Explanatory module, Forward and backward chaining

UNIT-II

Knowledge representation and inferencing. Building expert systems Suitability of task, architecture, hardware, software, personnel- Expert system building tools language, shells.

UNIT-III

Commercial software for manufacturing applications in CAD, CAPP, MRP, CAM, MRP II, Adaptive control of devices, Robotics, Process control, Fault diagnosis, Failure analysis etc.;

UNIT-IV

Linking expert systems to other software such as DBMS, MIS, MDB, Process control and office- automation.

UNIT-V

Case studies of typical applications in process planning, tool selection, cutting tool selection, part classification, inventory control, facilities planning, etc.

COURSEOUTCOMES:

At the end of the course student will be able to

1. Understand the Knowledge based systems involving real-time problems.
2. Develop the expert systems
3. apply expert system software for manufacturing applications
4. Link the expert systems to other software.
5. Solve the problems in the field of machining, inventory control, process planning with the help of expert systems.

REFERENCES

1. Adodji.B,BAd1I.NExpertSystemApplicationsinEngineering&Manufacturing —JohnWiley&Sons(l995)
2. Peter JacksonIntroductiontoExpertSystems.MartinMerryExpertSystem—85

PE15C ROBOTICS
M TECH I SEMESTER
PRODUCTION ENGINEERING
(Programme Elective- II)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Fundamentals of robotics – Automation and robotics, Robot Anatomy, Four common robot configurations – SCARA robot – kinematic joints – prismatic, revolute, twisting and revolving Robot wrist motions – YPR motions– Robot work volumes – Robot characteristics – Spatial resolution, Accuracy, Repeatability.

UNIT-II

Control Systems and components – Basic control systems components and models – Mathematical models, transfer function – Block diagrams, Characteristic equations – Controllers – Proportional control, Integral control, Proportional and Derivative (PD) control, Proportional and Integral (PI) control and PID Control. Stability and speed of response of a robot arm.

UNIT-III

Drive systems and sensors –Servo-controlled and non-servo-controlled robots. Powering of the robot arm – Hydraulic, Pneumatic, and Electric drives – Robot joint control design. Types of sensors – Contact and non–contact type sensors – Position sensors – velocity sensors – force sensors – torque sensors – Tactile sensors – proximity and range sensors – Vision sensors.

UNIT-IV

Trajectory planning of a robot arm – cubic polynomials – Trajectory planning and robot controller. Robot end–effectors – grippers and tools – Mechanical grippers – types of gripper mechanisms – gripper force analysis – vacuum grippers – magnetic grippers – Remote Centre Compliance (RCC) device.

UNIT-V

Robot arm kinematics – Homogeneous transformation matrix – DH matrix – Forward and Inverse kinematics of 2R and 3R robot manipulators, Robot Programming methods – Offline and online programming – Manual programming, Lead through programming, robot programming languages—industrial applications of robots.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Understand the fundamentals of robotics and its anatomy.
2. Analyze Robot Configuration and its controls.
3. Describe the Principles of robot programming and handle with a typical robot, control systems & sensors.
4. Analyze the Construction and working of robot components.
5. Design automatic manufacturing cells with robotic controls, robot kinematics, and programming.

REFERENCES

1. John J. Craig, Introduction to Robotics Mechanics and Control, Second Edition, Addison Wesly Longman Inc. International Student edition, 1999
2. Mark W. Sponge & Vidya Sagar M., "Robot Dynamics and Control," Wiley; 1st Edition (1989)
3. Tsuneo Yohikwa, Foundations of Robotics Analysis and Control, Prentice Hall of India Pvt. Ltd., 2001
4. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, "Industrial Robotics Technology, Programming and Applications," Mc Graw Hill Book Company, 1986
5. R.K. Mittal and I.J. Nagrath, "Robotics and Control," McGraw Hill Education (India) Private Ltd., 2014.
6. Gonzalez KSFURC and Lee C.S.G., "Robotics-Control, Sensing, Vision, and Intelligence" Mcgraw-Hill Book Company (July 1987).
7. Deb S.K, Deb,s "Robotics Technology and Flexible Automation", Tata McGraw-Hill Education Private Limited, 2009.
8. Ganesh S. Hegde, A textbook on Industrial Robotics, Laxmi Publications (P) Ltd., 2007.

PE15C DESIGN FOR MANUFACTURING
M TECH I SEMESTER
COMMON TO INDUSTRIAL ENGINEERING & PRODUCTION ENGINEERING
(Programme Elective- II)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Introduction: Design philosophy-steps in design process-general design rules for manufacturability-basic principles of designing for economical production-creativity in design.

Machining Processes: Overview of various machining processes-general design rules for machining- dimensional tolerance and surface roughness-Design for machining – ease – redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

UNIT-II

Metal Casting: Appraisal of various casting processes, selection of casting process, -general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting.

UNIT-III

Metal Joining: Appraisal of various welding processes, factors in the design of weldments – general design guidelines-pre and post-treatment of welds-effects of thermal stresses in weld joints-design of brazed joints. Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

UNIT-IV

Extrusion & Sheet Metal Work: Design guidelines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

UNIT-V

Plastics: Visco elastic and creep behaviour in plastics-design guidelines for plastic components-design considerations for injection moulding – design guidelines for machining and joining of plastics.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Perceive the principles and steps for designing products for economical production.
2. Simulate the casting design and choose the best casting process for a specific product.
3. Evaluate the effect of thermal stresses in weld joints and accessibility of welding processes.
4. Design components for sheet metal work by understanding the design guidelines and principles of sheet metal processes.
5. Design plastic parts for machining, joining, and selecting a proper method for different joining cases.

REFERENCES:

1. Design for manufacture, John cobert, Adisson Wesley. 1995
2. Design for Manufacture by Boothroyd,
3. Design for manufacture, James Bralla
4. ASM Handbook Vol.20

IE15C ENTERPRISE RESOURCE PLANNING
M.Tech I SEMESTER
Common to Industrial Engineering & Production Engineering
(Programme Elective- II)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Introduction to ERP: Enterprise – An Overview, Integrated Management Information, Business Modeling, Integrated Data Model

UNIT-II

ERP and Related Technologies Business Processing Reengineering (BPR), Data Warehousing, Data Mining, On-line Analytical Processing (OLAP), Supply Chain Management (SCM), Customer Relationship Management (CRM), MIS - Management Information System, DSS - Decision Support System, EIS - Executive Information System.

UNIT-III

ERP Manufacturing Prospective: MRP - Material Requirement Planning, BOM - Bill Of Material, MRP - Manufacturing Resource Planning, DRP - Distributed Requirement Planning, PDM - Product Data Management

UNIT-IV

ERP Modules Finance, Plant Maintenance, Quality Management, Materials Management

UNIT-V

Benefits of ERP Reduction of Lead-Time, On-time Shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Design-making Capability

COURSE OUTCOMES:

At the end of the course student will be able

1. To understand the basic concept of enterprise resource planning (ERP).
2. To analyse the related technologies of business processing reengineering.
3. To apply the concept of MRP 1, MRP 2, BOM, DRP and PDM.
4. To develop the ERP models.
5. To understand the ERP reduction of timings and benefits.

REFERENCE BOOKS:

1. Enterprise Resource Planning - Alexis Leon, Tata McGraw Hill.
2. Enterprise Resource Planning – Diversified by Alexis Leon, TMH.
3. Enterprise Resource Planning - Ravi Shankar & S. Jaiswal ,Galgotia

PE15C INTELLIGENT MANUFACTURING SYSTEMS
M TECH I SEMESTER
PRODUCTION ENGINEERING
(Programme Elective- II)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT I:
Computer integrated manufacturing systems – structure and functional areas of CIM system - AD, CAPP, CAM, CAQC, ASRS and advantages of CIM Manufacturing communication systems – MAP/TOP OSI model, data redundancy, top-down and bottom-up approach, volume of information. Intelligent manufacturing – system components, system architecture and data flow, system operation.

UNIT II:
Components of knowledge-based systems – basic components of knowledge based systems, knowledge representation, comparison of knowledge representation schemes, interference engine, knowledge acquisition Machine learning – concept of artificial intelligence, conceptual learning, and artificial neural networks -biological neuron, artificial neuron, types of neural networks, applications in manufacturing.

UNIT III:
Automated process planning – variant approach, generative approach, expert systems for process planning, feature recognition, phases of process planning knowledge Based System for Equipment Selection (KBSES) – Manufacturing system design, equipment selection problem, modelling the manufacturing equipment selection problem, problem solving approach in KBSES, structure of the KBSES.

UNIT IV:
Group technology: models and algorithms – visual method, coding method, cluster analysis method, matrix formation – similarity coefficient method, sorting-based algorithms, bond energy algorithm, cost-based method, cluster identification method, extended ci method.

UNIT V:
Knowledge-based group technology - group technology in the automated manufacturing system, structure of knowledge-based system for group technology (KBSGT) – data base, knowledge base, clustering algorithm.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Describe the performance of manufacturing systems.
2. Derive the systemic approach for designing and implementing manufacturing systems.
3. Analyse new procedures to improve productivity and existing manufacturing systems.
4. Explain and Analyse online collaboration tools to work in complex teams
5. Understand the group technology in automated manufacturing systems.

REFERENCES:

1. Andre Kusaic, "Intelligent Manufacturing Systems", PHI, 1989.
2. Hamid R.Parsaei and Mohammad Jamshidi, "Design and Implementation of Intelligent Manufacturing Systems", PHI, 2009.
3. Mikell P Groover, "Automation, Production Systems and Computer Integrated Manufacturing", 8th edition, PHI, 2008.
4. Yagna Narayana, "Artificial neural networks", PHI, 2009.

PE16L PRODUCTION ENGINEERING LAB –I
M TECH I SEMESTER

PRODUCTION ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 0-0-3-3

COURSE CONTENT:

LIST OF EXPERIMENTS:

1. Inspection of drill JIG.
2. Simulation of CNC programming, using XL turning m/c
3. Simulation of CNC programming, using milling m/c
4. Screw thread measurement using profile projector
5. Straightness testing by using the Wedge method.
6. Study of Measuring Instruments
7. Sine bar
8. Sand analysis

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Perform Drill jig inspection.
2. Write CNC programming for turning and milling
3. Understand the working of measuring instruments
4. Perform profile and straightness measurements.
5. Utilize the sine bar and sand analysis for the casting process.

PE17L CAD LAB

M TECH I SEMESTER

Instruction Hours/ Week: (L-T-P-C): 0-0-3-3

COURSE CONTENT:

1) Modeling and analysis of machine parts using modeling and simulation packages.
2) Minimum of four exercises in structural and thermal analysis is to be carried out.
3) A case study has to be done by the each student.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Understand the commands of CAD and CAE software's.
2. Able to analyse the structural problems and their solutions using CAE.
3. Able to analyse the thermal problems and their solutions using CAE..
4. Able to analyse manufacturing problems and simulation using the CAE software.
5. Able to apply CAD tools for design and manufacturing applications.

PE18C RESEARCH METHODOLOGY AND IPR
M.TECH I SEMESTER
PRODUCTION ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT-II

Effective literature studies approaches, analysis, Plagiarism, Research ethics.

UNIT-III

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT-IV

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT. Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT-V

New Developments in IPR: Administration of Patent System. New developments in IPR, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

COURSE OUTCOMES:

At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

REFERENCES*:*

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & Engineering students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

PE21C COMPUTER INTEGRATED MANUFACTURING
M.TECH II SEMESTER
PRODUCTION ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 3-1-0-4

COURSE CONTENT:

UNIT-I

Introduction: Scope of computer-integrated manufacturing, Product cycle, and Production automation.

Group Technology: Role of group technology in CAD/CAM integration, Methods for developing part families, Classification and coding, Examples of coding systems, Facility design using group technology, Benefits of GT.

UNIT-II

Computer Aided Process Planning: Role of Process Planning, Approaches to process planning- Manual, Variant, Generative approach; Examples of Process planning systems - CAPP, DCLASS, CMPP; Criteria for selecting a CAPP system, Benefits of CAPP.

UNIT-III

Integrative Manufacturing Planning and Control: Role of integrative manufacturing in CAD/CAM integration, Overview of production control - Forecasting, Master production schedule, Rough – Cut Capacity planning, MRP, Capacity Planning, Order release, Shop-floor control, Quality assurance, Manufacturing Planning, and control systems; Cellular manufacturing, JIT manufacturing.

UNIT-IV

Computer-Aided Quality Control: Terminology in quality control, Contact inspection methods, Non-contact inspection methods, Computer aided testing, and Integration of CAQC with CAD/CAM.

UNIT-V

Computer Integrated Manufacturing Systems: Types of manufacturing systems, Machine tools and related equipment, Material handling systems, Computer control systems, CIMS Benefits.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Define the scope of integrated manufacturing in production.
2. Different Approaches of the planning process in CAPP and their benefits
3. Design a manufacturing cell and cellular manufacturing system
4. Understand the Importance of inspection methods in CAQC
5. Explain types of manufacturing systems and material handling in CIM

REFERENCES*:*

1. Computer Integrated Design and Manufacturing by David D. Bedworth, Mark R. Henderson, Philip M. Wolfe.
2. CAD / CAM by Groover & Zimmers (PHI)
3. Automation, Production Systems, and Computer Integrated Manufacturing- by M.P.Groover (PHI)
4. "Computer Integrated Manufacturing System," Yorem Koren, McGraw-Hill, 1983.
5. "Computer Integrated Manufacturing," Ranky, Paul G., Prentice Hall International, 1986.

PE22C CUTTING TOOL DESIGN AND PRECISION MACHINE TOOL DESIGN STRATEGIES
M.TECH II SEMESTER
PRODUCTION ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 3-1-0-4

COURSE CONTENT:

UNIT-I

Cutting tool geometry – Tool terminology – Tool signature/nomenclature of single point cutting tool – Tool geometry in ASA, ORS, and NRS systems – Functional angles – true rake and inclination angle – Deformation of metals during cutting – Basic mechanics of metal cutting process – Mechanism of chip formation – Orthogonal cutting and Oblique cutting – Thin zone model and thick zone model – Types of chip – Chip curl – Chip breakers.

UNIT-II

Thin zone model – Merchant analysis – Kinematics of chip –Calculation of metal cutting strain – Measurement of Cutting forces – Dynamometry – Merchant theory and Lee and Shaffer theory – Friction in metal cutting – Effect of friction. Cutting tool materials – Coating of cutting tools – chemical vapor deposition and physical vapor deposition methods.

UNIT-III

Thermal aspects of machining and cutting temperatures and Acoustic Emission (AE) in metal cutting. Cutting fluids – Basic forms of wear in metal cutting – Adhesive, Abrasive and solid–state diffusion. Tool wear and Tool failure – crater wear and flank wear – wear land – Tool life equation – Variables affecting tool life—the economics of machining.

UNIT-IV

Fundamentals of drilling and grinding – Power of drilling – Theory of grinding – Cutting tool design – Types – single point and multi–point cutting tools – Design of a single point turning tool – strength and rigidity criteria – Design of multi–point cutting tools – Profile milling cutters, Drills, Broach and design of Form tools.

UNIT-V

Developments in cutting tool materials for high-speed machining, Introduction to micromachining, Differences between macro cutting and micro cutting, characteristics of micro cutting – size effect, minimum chip thickness, the specific power consumption, etc.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Describe cutting tool geometry and mechanism of chip formation.
2. Understand and explain merchant theory, Lee and Shaffer's theory
3. Understand the practical aspects of tool wear and tool life and their influence on economics
4. Analyze different types of tools and their applications
5. Describe macro and micro cutting and their characteristics.

REFERENCES:

1. N. Lopenz de Lacalle et al. Machine tools for high-performance machining, Springer, 2009.
2. Cyril Donaldson, Tool Design, Tata McGraw Hill Edition
3. ASTME Handbook Tool Design, PHI.
4. Tool Design Pollock, Reston D Taraporevala Sons,1983
5. Tool Design Nagpal, Khanna Publishers — 1991
6. G.Kuppuswamy, Principles of Metal Cutting, Orient Longmans, Hyderabad, India
7. B.L Juneja G.S.Sekhon — Fundamentals of Metal Cutting and MK tools, New Age India Pvt. Ltd. Publishers.

PE23C AUTOMATION IN MANUFACTURING
M.TECH II SEMESTER
PRODUCTION ENGINEERING
(Programme Elective Course – III)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Introduction: Types and strategies of automation, pneumatic and hydraulic components, circuits, automation in machine tools, mechanical feeding and tool changing, and machine tool control.

UNIT-II

Automated Flow Lines: Methods of part transport, transfer mechanism, buffer storage, control function, design, and fabrication considerations.
Analysis of automated flow lines - General terminology and analysis of transfer lines without and with buffer storage, partial automation, and implementation of automated flow lines.

UNIT-III

Assembly System And Line Balancing: Assembly process and systems, assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

Automated Material Handling And Storage Systems: Types of equipment, functions, analysis, and design of material handling systems, conveyor systems, automated guided vehicle systems. Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

UNIT-IV

Adaptive Control Systems: Introduction, adaptive control with optimization, adaptive control with constraints, application of adaptive control in machining operations. Consideration of various parameters such as cutting force, temperatures, vibration and acoustic emission in the adaptive controls systems.

UNIT-V

Automated Inspection: Fundamentals, types of inspection methods and equipment, Co-ordinate Measuring Machines, Machine Vision.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Understand the various types of automation systems.
2. Solve the line balancing problems in the various flow line systems with and without the use of buffer storage
3. Analyze the different automated material handling, storage and retrieval systems, and automated inspection systems.
4. Utilization of Adaptive Control principles and implementing the same online inspection and control
5. Understand the fundamentals of automation inspection methods.

REFERENCES:

1. Automation, Production Systems, and Computer Integrated Manufacturing/ M.P. Groover./ Prentice Hall
2. Computer Control of Manufacturing Systems / Yoram Coren/Tata McGraw-Hill edition
3. CAD / CAM/ CIM /P. Radhakrishnan, S.Subrahmanyam, V.Raju/New Age International Publishers
4. Automation / W. Buekinsham, 3rd Edition/PHI Publications

PE23C METAL FORMING TECHNOLOGY
PRODUCTION ENGINEERING
M.TECH SEMESTER II
(Programme Elective Course – III)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I
Characteristics of presses types of crank drives, eccentric, knuckle joint, rocker arm, non—geared and geared fly wheel type number of suspensions, use of counterbalances, etc. Types of friction screw presses — 3 wheels, 4 — wheel Vincent, percussion, Belta drive, electric and hydraulic screw drives.

UNIT-II
Input-output balance diagrams of these drives. Characteristics and stroke rating of these machines. Horizontal forge machine, press frame design, guides.

UNIT-III
Fundamental theories of plasticity and mechanics of plastic deformation equations, methods for solution of problems in metal formation processes.

UNIT-IV
Fluid power in metal forming and related machine tools. Introduction of symbols, pumps, accumulators, and valves. Classification of hydraulic presses extrusion, forging, and deep drawing presses — design features — choice of fluid in hydraulic presses.

UNIT-V
Column design in hydraulic presses. Comprehensive design analysis of a deep drawing press and extrusion press. Hammers for hammer forgings. Classification based on action, stands, controls, and power medium. Theoretical principles involved in estimating the efficiency of a hammer, number of strokes, and power variation during — a play hammer.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Understand Metal forming fundamentals and applications.
2. Analyze Metal forming mechanics.
3. Understand plastic deformation takes place in Metal forming
4. Application of Fluid hydraulics in Metal forming
5. Design analysis of presses and Explain hammer forging and its efficiency

REFERENCES

1. Row., Metal Forming Technology
2. Crane, Press Working of Metals, John Weliy & Sons, 1957

PE23CQUALITY CONTROL AND RELIABILITY
M.TECH I SEMESTER
PRODUCTION ENGINEERING
(Programme Elective Course – III)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Basic Concepts: Definitions of quality, Quality of design, Quality of conformance, and Quality of performance, Dimensions of quality, Quality characteristics, Quality control, Statistical quality control and cost of quality.

Fundamentals of Probability and Statistics: Events, Sample space, Probability rules, Dependent and Independent events, Statistical tools in quality control, Concept of variation, Graphical tools for data representation and analysis, Discrete and continuous probability distributions and their applications in quality control, numerical problems

UNIT-II

Control charts for Variables: Variation, Causes of variation, Objectives of control charts, Choice of variable, Subgroup size and sub grouping, frequency of sampling, control limits. Process capability analysis, Relationship of a process in control to specification limits, Variable charts - X bar chart, R chart, σ chart, revision of control limits and RPI, Introduction to custom chart and moving range charts, numerical problems.

UNIT-III

Control charts for Attributes: Control charts for fraction nonconforming (p chart, np chart) and nonconformities (c chart and u chart) with variable and constant sample size, Choice between variables and attributes control charts, revision of control limits, numerical problems.

Failure Data Analysis : Introduction, Failure Data, Quantitative measures, MTTF, MTBF, Bathtub Curve, Mean Life, Life Testing, numerical problems, Introduction to Failure Mode and Effect Analysis.

UNIT-IV

Acceptance Sampling: Fundamentals of acceptance sampling, Sampling methods, OC Curves and their characteristics, AQL, IQL, LTPD, AOQ/AOQL.

Types of acceptance sampling-Single, Double, Multiple, and Sequential sampling plans, Average Total Inspection, comparison amongst sampling plans, numerical problems.

UNIT-V

System Reliability: Definition, Series, parallel and mixed configuration, Block diagram concept, r-out-of-n structure solving problems using mathematical models. Difficulty in achieving reliability, Methods for improving reliability during design, Different techniques available to improve reliability, Reliability-Cost trade off, Prediction and Analysis, numerical problems.

Maintainability and Availability: Introduction, Techniques available to improve maintainability and availability, trade-off among reliability, maintainability and availability, Simple problems

COURSE OUTCOMES:

At the end of the course student will be able to

1. To understand basic concepts of quality control.
2. To apply the control charts of variables (X bar ,P bar charts) for different applications.
3. To apply the control charts of attributes (C bar ,N bar charts) and **conduct Failure Analysis**
4. To apply acceptance sampling plans for quality control.
5. Understand the concepts of reliability management, and **Maintainability and Availability:**

REFERENCES:

1. Fergenbaum,V. Armand, Total Quality Control — Tata MeGrawhill(40th Edition)
2. Besterfield H. Dale., Quality Control — A practical approach — Pearson Education Asia (2nd Edition).
3. Grant, E. L., Statistical Quality Control — Tata Mc Grawhill (6th Edition)
4. Montgomary — Statistical Quality Control — John Wiley & Sons
5. Srinath, L.S., Concepts in Reliability Engineering — Prentice Hall India.

PE23C FINITE ELEMENT METHOD
M.TECH II SEMESTER
PRODUCTION ENGINEERING
(Programme Elective Course – III)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Overview of FEM: Basic concepts – Historical background – General applicability of methods – one-dimensional heat transfer, fluid flow, solid bar under axial load – Engineering applications of finite element method– general procedure in FEM – comparison of FEM and other solutions methods.

UNIT-II

Approximate methods of Analysis: Methods of Weighted residuals – point collocation – Collection of sub-regions – least squares -Galerkin method, - Rayleigh`s method, Rayleigh-Ritz method, Ritz method, FDM

Discretization of Domain: Introduction to the discretization of Domain – Basic element shapes – Discretization process –Types of elements and sizes – Finite representation of bodies – Node Numbering scheme –Automatic mesh generation methods.

UNIT-III

Interpolation Methods: Introduction to interpolation polynomials – Polynomial forms of interpolation functions –Simplex, complex and multiplex elements – interpolation polynomial in terms of nodal degrees of freedom – Selection of order of interpolation polynomial – Convergence requirements – linear interpolation polynomials in terms of global co-ordinates - interpolation polynomials in terms of local co-ordinates.

UNIT-IV

Higher Order and Iso Parametric Elements: Higher order one-dimensional elements – Higher order elements in terms of natural co-ordinates - Higher order elements in terms of interpolation polynomials, One-Dimensional elements, and two-dimensional elements using classical interpolation polynomials – comparative studies of elements – Iso parametric elements - shape function in co-ordinate transformation –continuity and compatibility – Numerical integration

UNIT-V

Applications in Solid Mechanics: Introduction - Plane stress – Plain strain rectangular element – Iso parametric formulation –Axis- metric stress analysis

Applications in Heat Transfer: Introduction – One-dimensional heat conduction: quadratic element – One-dimensional heat conduction with convection

Applications in Fluid Mechanics: Introduction – Governing equation for incompressible flow: Rotational and Irrotational.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Understand the General procedure of FEM and its applications
2. Elaborate on different analysis methods of FEM
3. Describe polynomial forms of interpolation
4. Evaluate high-order one-dimensional elements and iso parametric elements
5. Analyze the various applications of FEM in engineering.

REFERENCES:

1. Finite element method in Engineering – SS. Rao, Edition 4, Elsevier Publications, 2004
2. Fundamentals of Finite Element Analysis, David V. Hutton., Mc Graw Hill Publications, 2004
3. An Introduction to Finite Element Method, Reddy J.N., Mc Graw Hill Publications
4. Introduction to Finite Elements in Engineering: Chnandrupatla T.R.& Belegundu A.D, Pearson education publishers, 4th edition. 2009
5. Finite Element Procedures, Klaus-Jurgen Bathe, Prentice Hall Professional, Revised Edition.1995.

PE24C ADVANCED WELDING PROCESSES
M.TECH II SEMESTER
PRODUCTION ENGINEERING
(Programme Elective Course – IV)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I
General survey and Classification of welding processes. Conventional gas welding and cutting. Manual metal arc welding. Electrode coverings and their functions. Continuous processes based on the above.

UNIT-II
Submerged arc welding — types of fluxes and their compounding Wire and strip electrodes. Gas-shielded welding TIG and MIG and MAG/ CO_2 processes. Consideration of shielding gases, electrode polarity, current setting, metal transfer, and arc length control. Plasma welding and cutting processes. Equipment maintenance, application of the above.

UNIT-III
Electrical power sources for welding; General characteristics of transformer, transformer—rectifier, and motor generator sets. Use of pulsed currents. Pressure welding processes Solid phase bonding, friction welding, and ultrasonic welding.

UNIT-IV
Explosive welding, Diffusion bonding, and adhesive bonding. Resistance welding Spot, Seam and projection welding, Flash and upset butt welding.

UNIT-V
Brazing and soldering: Electron Beam, Laser, and Infrared Welding. Principles, Operational details, process controls, and application of the above processes.

COURSE OUTCOMES:
At the end of the course, students will be able to

1. Understand the different weldability testings for different metals.
2. Describe the different types of welding and its applications.
3. Explain the electric power sources for welding and pressure welding processes.
4. Understand the different types of bondings and their advantages.
5. Distinguish between brazing and soldering and their applications.

REFERENCES

1. The Science and Practice of Welding by Davies, A.C., Cambridge Low Price Edition
2. Welding Processes by Houldcroft, P. T., PHI Publications
3. Welding Technology by Konigsberger, F. Mc Graw Hill Publications
4. Welding and Welding Technology by Little, Richard L, TATA Mc Graw Hill Publications.
5. Welding Engineering by Rossi, Boniface E, PHI, Publications
6. Advanced Welding Systems. Vol.1; Vol.2 and 3 by Jean Cornu, USA Edition.

PE24C OIL HYDRAULICS AND PNEUMATICS
M.TECH II SEMESTER
PRODUCTION ENGINEERING
(Programme Elective Course – IV)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I
Introduction
Functional requirements of power transmission, different types of power transmission systems and their combinations; Fundamentals of oil hydraulics and pneumatics, Control functions of oil hydraulic systems; Comparison between Mechanical, Oil Hydraulic, Pneumatic, and Electrical power transmission systems; Advantages, disadvantages, and Applications of Oil Hydraulic and Pneumatic power transmissions.

UNIT-II
System Components
Hydraulic & Pneumatic Symbols as per ISO/ANSI, Properties and selection of hydraulic fluids, Filtration, Hydraulic Reservoirs, Accumulators, Intensifiers or Pressure Boosters, Seals, and Packing.

UNIT-III
Oil Hydraulic Pumps and Actuators
Construction, the working Principle and operation of rotary & reciprocating pumps like Gear, Vane, Generated-Rotor, Screw, Axial Piston, Radial Piston, Pump characteristics, Specifications and selection of pumps; Linear actuators like Ram type, Telescopic, and Single acting/double acting, types of their constructions, types of mountings, cylinder materials, cushioning of hydraulic cylinders, Rotary actuators, specifications, sizing and selection of pumps and actuators.

UNIT-IV
Control Valves
Construction, working Principle, and operation of Direction control valves, Flow control valves, and Pressure control valves, including Check, Pressure relief, Compound Pilot operated Pressure Relief, Safety, Sequence, Pressure Reducing, Unloading, and Counterbalance valves—different types of center positions of DCVs, Methods of actuation of DCVs.
Hydraulic and Pneumatic Controllers used in Feedback Control systems
Construction, working Principle, and operation of Proportional and Servo control valves, including Servo-type DCV-like nozzle valves, flapper-type valves, mechanical servo valves, single and double stage servo valves; Applications of servomotor systems in feedback control systems.

UNIT-V

Hydraulic Circuits

Reciprocation, quick return, sequencing, flow control circuits, synchronizing circuits, accumulator circuits, industrial circuits like press circuits, machine tool circuits, forklift, earth mover circuits- design and selection of components.

Pneumatic circuits

Compressed air production and distribution, pneumatic control components, examples of application including electro-pneumatic and hydro-pneumatic controls.

COURSE OUTCOME:

At the end of the course, students will be able to

1. Analyze the functional requirements of a power transmission system for a given application.
2. Understand the system components of Hydraulic and pneumatic symbols.
3. Design an appropriate hydraulic or pneumatic circuit, and develop a circuit diagram.
4. Describe the control valves and Hydraulic and pneumatic controller and their applications.
5. Design the hydraulic and pneumatic circuit and its selection.

REFERENCES:

1. Industrial Hydraulics by John Pippenger and Tyler Hicks, McGraw Hill.
2. Oil Hydraulic Systems, Principle and Maintenance by S R Majumdar, McGraw-Hill.
3. Fluid Power with Applications by Anthony Esposito, Pearson.
4. Fluid Power: Generation, Transmission and Control, Jagadeesha T., Thammaiah Gowda, Wiley.
5. The Analysis & Design of Pneumatic Systems by B. W. Anderson, John Wiley.
6. Control of Fluid Power Analysis and Design by Mc Clay Donaldson, Ellis Horwood Ltd.
7. Hydraulic and Pneumatic Controls: Understanding made Easy, K.Shanmuga Sundaram, S.Chand & Co Book publishers, New Delhi, 2006 (Reprint 2009)

PE24C PRODUCTIVITYENGINEERINGMANAGEMENT
M.TECH II SEMESTER
Common to Industrial Engineering & Production Engineering

(Programme Elective Course – III)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Basic definitions and Scope - Significance of Productivity in economic development. Productivity measurement at nation level. Benefits of higher productivity at firm level. Diversity of productivity concepts.

UNIT-II

Productivity measurement models—Partial Productivity models, the multi—factor productivity Computers for productivity measurement. Productivity Evaluation Productivity Models, Total Model, Objectives Matrix. Expression for Total Productivity change, the Productivity Evaluation Tree.

UNIT-III

Productivity Planning- Long and Short Term Productivity models—Causes of low productivity in companies — various strategies for productivity improvement. The Analytical Productivity Model.

UNIT-IV

Productivity Management at Enterprise level—Productivity Improvement Techniques—Technology based, Materials based, Product based, employee based and cost based. Productivity in service industries

UNIT-V

Case Studies, R&D Productivity, Evaluation of R&D, productivity, Technology Transfer.

COURSEOUTCOMES:

At the end of the course student twill be able to

1. Analyze the significance of productivity measurement at national level and firm level
2. Implement the Productivity measurement models.
3. Develop Productivity Planning
4. Apply Productivity Improvement Techniques
5. Carryout case studies of productivity improvement for entrepreneur ship development and technology transfer.

REFERENCES

1. Sumanth David, J., Productivity Engineering and Management — McGrawhill Book(1984)
2. Scott, Sink, D., Productivity Management Planning, Measurement and evaluation, control and Improvement.

PE24C ENERGY MANAGEMENT

M.TECH SEMESTER II

Common to Industrial Engineering & Production Engineering

(Programme Elective Course – IV)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Introduction: Principles of energy management. Managerial organization, Functional areas fori) manufacturing industry, ii) Process industry, iii) Commerce, iv) Government, Role of Energy manager in each of these organizations. Initiating, Organizing, and managing energy management programs

UNIT-II

Energy Audit: Definition and concepts. Types of energy audits, Basic energy concepts, and Resources for plant energy studies. Data gathering, Analytical techniques. Energy Conservation: Technologies for energy conservation, design for conservation of energy materials, and Energy flow networks. Critical assessment of energy usage. Formulation of objectives and constraints, Synthesis of alternative options, and technical analysis of options. Process integration.

UNIT-III

Economic Analysis: Scope, Characterization of an investment project. Types of depreciation, Time value of money. Budget considerations, Risk analysis.

UNIT-IV

Alternative Energy Sources:

Solar Energy – Types of devices for Solar Energy Collection – Thermal Storage System – Control Systems-

Wind Energy – Availability – Wind Devices – Wind Characteristics – Performance of Turbines and Systems.

UNIT-V

Bio-Mass: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation, and economic aspects.

Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India.

Ocean Energy: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Describe the principles and functional area of energy management.
2. Learning the basics of energy auditing with applications in different sectors.
3. Evaluate risk analysis and decision estimations in budget.
4. Identify opportunities for increasing the rational use of alternative energies.
5. Analyze the biomass system, conversion, and utilization.

REFERENCES:

1. Energy Management Hand Book / W.C. Turner (Ed)
2. Renewable Energy Sources fTwideil & Weir
3. Solar Energy /Sukhatme
4. Energy Management Principles / CB Smith/ Pergamon Press
5. Energy Management / W.R.Murthy and G.Mc.Kay / BS Publication
6. Management / H.Koontz and Cyrill Donnel / McGraw Hill
7. Rai G.D. : Non-conventional Energy Sources, Standard Publishers Distributors

PE25L PRODUCTION ENGINEERING LAB –II
M.TECH II SEMESTER
PRODUCTION ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 0-0-3-1.5

COURSE CONTENT:

LIST OF EXPERIMENTS:

1. Measurement of cutting forces using lathe tool dynamometer.
2. Measuring cutting forces using a drill dynamometer
3. To determine the major & minor flank angle of a particular screw by using the tool makers microscope.
4. To arrange the dividing head for differential indexing, to divide a circular part into a number of parts, using differential indexing.
5. Surface roughness measurement by using Talysurf
6. Measurement of cutting forces in milling
7. Spur gear measurement
8. Welding
9. To write a manual part program for the profile turning cycle to the given dimensions for a typical part.
10. To write the manual part program for the drilling operation

COURSE OUTCOMES:

At the end of the course student will be able to

1. Measure cutting forces using a dynamometer for the lathe, drilling, and milling machines, and arrange differential indexing.
2. The major and minor flank angles of the screw by using a toolmakers microscope
3. The surface roughness using Talysurf and Spur gear measurement
4. Perform welding and analysis
5. Part programming for the given typical part and manual part programming for the drilling operation

PE26L CAM LAB

M.TECH II SEMESTER

PRODUCTION ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 0-0-3-1.5

COURSE CONTENT:

LIST OF EXPERIMENTS:

1. Preparation of process planning.
2. CNC programming using G & M codes for the given work piece & also shows the simulation using CNC lathe software.
3. Simulation & execution of a part program for a given component using CNC milling.
4. Fabrication of a component using CNC Lathe.
5. Fabrication of a component using CNC machining center.

Note: Conduct at least 8 Exercises in the above topics.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Define the preparation o process planning.
2. Write a Program for a CNC lathe using G&M codes
3. Analyze the simulation of the CNC lathe process and execute a part program.
4. Write a Program for CNC milling using G&M codes
5. Analyze the simulation of CNC milling and execute a part program for a given component.

PE27C LEADERSHIP QUALTIES FOR ENGINEERS

M.Tech II Semester

Common to Industrial Engineering & Production Engineering

(Value Added Course)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Introduction to Leadership Roles, functions and characteristics of a leader, evolution and growth of leadership, Leadership traits and ethics, Attitude, Behavior, Personality traits and leadership, Types and Styles of leadership, Leader vs Manager, Essential qualities of an effective leader.

UNIT-II

Leadership and Management (Nature, Scope and Significance of Management, Levels of Management, Functions: Planning, Organizing, Staffing, Directing and Controlling, Skills: Conceptual, Human and Technical, Roles: Interpersonal, Informational and Decisional, difference between a leader and a manager)

UNIT-III

Types of Leaders, Leadership styles: Traditional, Transactional, Transformational, Inspirational and servant leadership and Emerging issues in leadership: Emotional Intelligence and leadership, Trust as a factor, Gender and Leadership.

UNIT-IV

Personality: Concept and Definition, Determinants of personality, Personality traits, Personality characteristics in organizations: Self-evaluation, Locus of control, Self-efficacy, Self-esteem, Self-monitoring: Positive and negative Impact.

UNIT-V

Self-Discovery (Awareness of personal values, beliefs and vision that motivates behavior, Personal SWOT, Trust: Openness, confidentiality, blind spot and unknown part of personality, Self-disclosure, seeking feedback, self-reflection, introspection and self-management.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. To understand the leadership roles.
2. To apply the concepts of Leadership and Management.
3. To understand and apply the concepts of Leadership styles.
4. Inculcate and apply personality development aspects.
5. To inculcate and create awareness.

REFERENCES:

1. Organizational Behaviour, M.Parikh and R.Gupta , Tata McGraw Hill Education Private Limited

2. Organizational Behavior, D. Nelson, J.C Quick and P. Khandelwal, Cengage Publication.

PE27C STRESS MANAGEMENT

M.Tech II Semester

Common to Industrial Engineering & Production Engineering

(Value Added Course)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Meaning and nature of stress: Difference between eustress and distress; Frustration, conflict and pressure; Meaning of stressors; common stressors at work place: Stressors unique to age and gender. Stress and Memory; Stress and Other Cognitive Variables; Stressful environmental conditions on performance.

UNIT-II

Behavioural aspects of Stress: Adaptive and Maladaptive Behaviour; Individual and Cultural Differences: Sources of Stress- Across the Lifespan; College and Occupational Stress.

UNIT-III

Stress and Work performance: Role of communication in managing stress and work performance: Emotional regulation and coping; Emotional intelligence and conflict management: Emotional Basis and Stress; Stress and Conflict in Relationships. Stress intervention – interpersonal, Management Standards and Management Competencies.

UNIT-IV

Strategies of Stress Management: Prevention of stress Challenging Stressful Thinking; Problem Solving; Emotional and cognitive coping styles: Strategies of Synthesis and Prevention: Resilience and Stress; Optimal functioning; Making changes last; Small changes and large rewards.

UNIT-V

Preparing for the Future: Care of the Self: Nutrition and Other Lifestyle Issues: Stress reduction practices: Time management; Exercise; Relaxation techniques; yoga; meditation.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. To understand the cognitive variables of stress and Learn Managing Work-Life Balance
2. Preparing for better future by reducing the stress.
3. To understand the nature and consequences of stress
4. To understand the impact of stress on work.
5. To recognize the stressors, Adaptive and Maladaptive behavior

REFERENCES:

1. Baron .L & Feist.J (2000) Health Psychology 4th edition, USA Brooks/Cole
2. Barlow, Rapee, and Perini(2014), 10 Steps to Mastering Stress: A Lifestyle Approach, USA
3. Clayton,M, (2011).Brilliant stressmanagement How to manage stress in any situation's 1st edition, Greart Britain Pearson Education
4. Cooper,C,& Palmer,S, (2000)Conquer Your Stress, London: Institute of personal development Universities Press
5. Dutta, P,K, (2010) Stress management Himalaya, Himalaya Publishing House
6. Lee, K. (2014). Reset: Make the Most of Your Stress: Your 24-7 Plan for Well-being. Universe Publishing.

PE27C UNIVERSAL HUMAN VALUES

M.Tech II Semester

Common to Industrial Engineering & Production Engineering

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Introduction to Value Education : Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations.

UNIT-II

Harmony in the Human Being : Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.

UNIT-III

Harmony in the Family and Society: Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.

UNIT-IV

Harmony in the Nature/Existence : Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence.

UNIT-V

Implications of the Holistic Understanding – a Look at Professional Ethics : Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession.

COURSE OUTCOMES:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS.'
2. To ensure sustained happiness and prosperity which are the core aspirations of all human beings
3. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence.
4. To develop a holistic perspective of Universal Human Values and movement towards value-based living in a natural way.
5. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

REFERENCES:

1. Jeevan Vidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal.

IE28M MINI PROJECT WITH SEMINAR

Instruction Hours/ Week: (L-T-P-C): 1-0-2-2

COURSE CONTENT:

The students are required conduct experimental work/mathematical modelling/simulation on software packages etc. And collect relevant for analysis, and deduct the conclusions from results. Finally, the student should prepare the report and give seminar on project.

COURSE OUTCOMES:

At the end of this course, students will be able to

1. Apply emerging technology in processes and systems
2. Analyze the results
3. Deduct conclusions from results
4. Prepare report/document
5. Present effectively.

Semester III & IV
PE33ED and PE41D Dissertation Work

Phase–I, Phase–II and Viva-Voce

GUIDELINES FOR DISSERATION PHASE-I AND DISSERATION PHASE-II:

1. The dissertation is a yearlong activity; to be carried out and evaluated in two phases i.e. Phase–I in sem-3andPhase–II in sem-4.

2. The dissertation may be carried out in department laboratories/ industry.

3. After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives.

4. Phase–I evaluation: A committee comprising of guides o respective specialization shall assess the progress/ performance of the student based on report, presentation and Q&A. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.

5. During phase – II, student is required to continue Phase-1 as per the schedule and thesis (combined phase-1&2) should be submitted at end of sem-4. Accomplished results/contributions/innovations should be published in reputed journals/ conferences/Patents.

6. Phase – II evaluation: Guide, committee with external examiner shall assess the progress/performance of the student based on report, presentation and Q&A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work.

COURSE OUTCOMES:

At the end of this course, students will be able to

1. Synthesize knowledge and skills previously gained and applied to anin-depth study and execution of new technical problem.
2. Select different methodologies to carry out the selected project work.
3. Deduct conclusions from results
4. Prepare report/document
5. Present effectively

S.V.U. COLLEGE OF ENGINEERING :: TIRUPATI

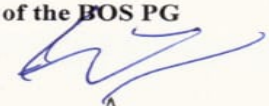
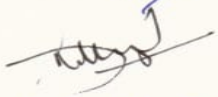
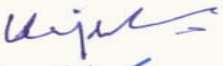
DEPARTMENT OF MECHANICAL ENGINEERING

SVUCE/MED/Minutes/2023 Dt. 02.06.2023

A meeting of the Joint Boards of Studies (PG) of all PG programmes in all the disciplines of Engineering is conducted at 10-30 A.M. on 02-06-2023 (Friday) in Room No. 200 online/offline mode to consider and discuss M.Tech. R-23 regulations, scheme and syllabus of all PG programmes for the Academic Year 2023-2024.

BOARD OF STUDIES (PG) MEETING RESOLUTION

Members of the BOS PG

1. Prof. P. Venkataramaiah : 
   Chairman
2. Prof V. Diwakar Reddy : 
   Head &, Ex-Officio Member
3. Sri K. Rajesh Babu : 
4. Dr. K. Dharma Reddy : 
5. Dr. Hema Pothur : 
6. Prof. G. Prasanthi : Attended Online
   Dept. of Mechanical Engineering
   JNTU, Anantapur
7. Dr. N. Venkaiah :
   Dept. of Mechanical Engineering
   Indian Institute of Technology,
   Tirupati

MINUTES

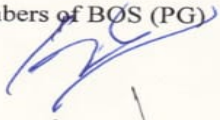
After the meeting of Joint Boards of Studies (PG), the Board of studies of Mechanical engineering meeting is conducted from 1-30 PM on 02-06-2023 (Friday) in committee hall of mechanical engineering.

It is resolved to consider M. Tech. R-23 regulations, scheme and syllabus of two PG programmes:

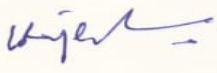
1) Industrial engineering

2) Production engineering for the Academic Year 2023-2024.

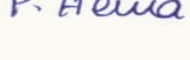
The members of BOS (PG)

1 

2 

3 

4 

5 

6

7



SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Curriculum & Syllabi for Water Recourses Engineering

(w.e.f 2018-19)

MAY,2018

PROGRAM OBJECTIVES

1. To provide the students by applying the knowledge of basic sciences and engineering in the field of water resources engineering.
2. To develop ability among the students to analyze the hydrological and water resources engineering data.
3. Plan and design of water resources system
4. To analyze complex field situations and providing solutions in water resources management.
5. To promote student awareness for life-long learning and knowing the importance of professional ethics and professional practices in Water resources engineering.

PROGRAMME OUTCOMES (POs)

At the end of the program the students will able to

1. Understand the concepts of fluid mechanics model studies and their computations in hydraulic engineering.
2. Analyze hydro meteorological data and various components of hydrological cycle and assess surface and groundwater surface.
3. Develop strategies to manage hydrological extremes and mitigate the impacts of climate change.
4. Engage in critical thinking and pursue investigations/research and development to solve practical problems.
5. Communicate effectively, write and present technical reports on complex engineering activities by interacting with Engineers and with society large.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1. Plan, Design, test and evaluate Water Resources system for meeting socio-economic and environmental needs of optimal utilization of available resources.
2. Development of state of art skills for using modern tools, as entrepreneur in the domain field or in multidisciplinary environment.

M.Tech (HYDRAULICS AND WATER RESOURSE ENGINEERING) – I Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
HWPC01	Advanced Fluid Mechanics	3	-	-	3	3	40	60	100
HWPC02	Free Surface Flows	3	-	-	3	3	40	60	100
Professional Elective- I Any One from the Following		3	-	-	3	3	40	60	100
HWPE11	Fluvial Hydraulics								
HWPE12	Hydraulic Structures								
HWPE13	Systems Engineering								
HWPE14	Hydraulic Modeling and Experimental techniques								
Professional Elective- II Any One from the Following		3	-	-	3	3	40	60	100
HWPE21	Water Resources System Planning								
HWPE22	Irrigation and Drainage								
HWPE23	Water Power Engineering								
HWPE24	Urban Hydrology								
HWCP01	Advanced Fluid Mechanics Lab	-	-	4	4	2	40	60	100
HWCP02	Advanced Hydrology Lab	-	-	4	4	2	40	60	100
HWPA01	Audit Course-I	2	-	-	2	-	100	-	100
PGPC41	Research Methodology and IPR	2	-	-	2	2	40	60	100
	Total	16	-	8	24	18	380	420	800

M.Tech (HYDRAULICS AND WATER RESOURSE ENGINEERING) – II Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Exam Marks	Total
HWPC03	Advanced Hydrology	3	-	-	3	3	40	60	100
HWPC04	Groundwater Engineering	3	-	-	3	3	40	60	100
Professional Elective- III Any One from the following		3	-	-	3	3	40	60	100
HWPE31	Computational Methods in Fluid Mechanics								
HWPE32	Theory and Applications of GIS								
HWPE33	Hydrogeology and Geophysical exploration of groundwater								
HWPE34	Coastal Engineering								
Professional Elective- IV Any One from the Following		3	-	-	3	3	40	60	100
HWPE41	Environmental Hydraulics								
HWPE42	Advanced Numerical Analysis								
HWPE43	River Water Management								
HWPE44	Theory of Seepage and groundwater movement								
HWCP03	Computational Fluid Dynamics Lab	-	-	4	4	2	40	60	100
HWCP04	Open Chanel Flow Lab	-	-	4	4	2	40	60	100
HWPA02	Audit Course-II	2	-	-	2	-	100	-	100
HWMP01	Mini Project	2	-	-	2	2	100	-	100
	Total	16	-	8	24	18	440	360	800

M.Tech (HYDRAULICS AND WATER RESOURSE ENGINEERING) – III Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Professional Elective- V Any One from the following		3	-	-	3	3	40	60	100
HWPE51	Computer Methods in Hydraulics and Hydrology								
HWPE52	Stochastic Hydrology								
HWPE53	Watershed Management and Modeling								
HWPE54	Climate Change and Sustainable Development								
Open Elective- I Any One from the Following		3	-	-	3	3	40	60	100
HWOE11	Business Analysis								
HWOE12	Industrial Safety								
HWOE13	Operations Research								
HWOE14	Cost Management of Engineering Projects								
HWOE15	Composite Materials								
HWOE16	Energy Generation from Waste								
HWPD01	Major project: Phase-I Dissertation	-	-	20	20	10	100	-	100
	Total	6	-	20	26	16	180	120	300

M.Tech (HYDRAULICS AND WATER RESOURSE ENGINEERING) – IV Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
HWPD02	Major project: Phase-II Dissertation	-	-	32	32	16	40	60	100
Total		-	-	32	32	16	40	60	100

HWPC01ADVANCED FLUID MECHANICS

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks: 60**

UNIT I: Kinematics of Flow: Equation of continuity in cartesian, polar and cylindrical coordinates, Standard 2D Flow Patterns: Source, sink, doublet and their combinations, construction of flows bysuperposition, D'Alembert's paradox

UNIT II:Ideal fluid flow

Simple patterns of 2-dimensional flow - Uniform flow, Source, sink, vortex flow, Superposition of elementary flows – Doublet – Rankine-half body - Rankine oval, flow about a circular cylinder and flow about a rotating cylinder.

UNIT III:. Laminar Flow: Derivation of Navier-Stokes equations – exact solutions for flow between parallelplates, Couette flow, flow near a suddenly accelerated plate and an oscillating plate.

UNIT IV: Boundary Layers: Similarity solutions of boundary layer equations, Falkner-Skan Wedge flows,Karman's momentum integral equations, Karman-Puhlhausen approximate solution, separation in boundary layer under adverse pressure gradient, turbulent boundary layer.

UNIT V: Turbulent Flows: Reynolds equations of motion, semi-empirical theories of turbulence, velocityprofiles for inner, outer and overlap layers, equilibrium boundary layers.

References:

1. White, F.M., "Fluid Mechanics", McGraw-Hill. 1979
2. Schlichting, H., "Boundary Layer Theory", McGraw-Hill. 1979 Garde, R.J., "Turbulent Flow", Wiley Eastern Limited. 1994
3. Pope, S. B., "Turbulent Flows", Cambridge University Press. 2000
4. Rouse, H., "Advanced Mechanics of Fluids", John Wiley and Sons. 1959
5. Ojha, C.S.P., Berndtsson, R. and Chandaramouli, P.N., "Fluid Mechanics", Oxford University Press. 2010

Course Outcomes (COs)

After completion of the course the student will have:

1. Able to analyze the fluids in motion condition
2. Able to apply the principles of ideal fluid flow and real fluid flow
3. Able to apply the principles of viscous flow of fluids
4. Able to find out different layer of boundary layer and identifying the separation

and control

5. Able to analyze the fluids in turbulent flow conditions.

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	2	1	-	1	-		3	-
CO2	2	1	-	1	-		3	-
CO3	2	1	-	1	-		3	-
CO4	2	1	-	1	-		3	-
CO5	2	1	-	1	-		3	-

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPC02FREE SURFACE FLOWS

L / week : 3 Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT I

INTRODUCTION: Free surface flows, velocity distribution, resistance relationships, specificenergy and specific force, normal and critical depths computations, governing equation and computation of gradually varied flows.

UNIT II

HYDRAULIC JUMP: Elements of hydraulic jump, hydraulic jump in variety of situationsincluding contracting and expanding geometries and rise in floor levels, control of hydraulic jump using baffle walls and cross jets.

UNIT III

SUPERCRITICAL FLOWS: Flow past deflecting boundaries, oblique shock waves.

Spatially Varied Flows: Flows past side weirs, De Marchi equations, design of side weirs, flow past bottom racks, trench weirs and waste water gutters.

UNIT IV

AERATED FLOWS: Bulking of flow, mechanism of air entrainments, modelling of aeratedflows, development of self-aerated flows, uniform aerated region, aeration over spillway.

Stratified Flows: Thermal stratification in water bodies including reservoirs, modelling of stratified flows.

UNIT V

UNSTEADY FLOWS: St. Venant's equations and their solution using method of characteristicsand finite difference schemes; dam break problem, hydraulic flood routing.

Channel Transitions: Sub-critical and supercritical.

References:

1. Chow, V.T., “Open Channel Hydraulics”, McGraw Hill. 1959
2. Choudhary, M.H., "Open-Channel Flows", Prentice-Hall. 1994
3. Ranga Raju, K.G., “Flow Through Open Channels, Tata McGraw Hill. 2003
4. Chanson, H., “The Hydraulics of Open Channel Flow: An Introduction”, Elsevier. 2004 French, R.H., "Open-Channel Hydraulics", McGraw-Hill. 1994
5. Wood, I.R., “Air entrainment in free-surface flows”, A.A. balkema. 1991

Course Outcomes

1. Able to compute flow profile in channel transition
2. Able to apply various principles in unsteady flow conditions
3. Able to formulate and solve the hydraulic flood routing
4. able to apply concepts on aerated flows.

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	3	1	-	2	-		3	-
CO2	2	1	-	2	-		3	-
CO3	2	1	-	2	-		3	-
CO4	2	1	-	2	-		3	-

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPE11 FLUVIAL HYDRAULICS

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

The sediment problems, properties of sediments, incipient motion of uniform and non-uniform sediments. Bed forms- mechanics of bed forms, classifications and channel resistance.

UNIT II

Bed load equation, Bed layer characteristics, sediment sampling, measurement and suspended load – sediment concentration, Advection-diffusion equation, suspended sediment concentration profile, Hyper concentration, Field measurements of suspended sediments.

UNIT III

Stable channel design and sediment control – Introduction- variable in channel design and conditions – secondary factors influencing stable channel design- stable channel carrying clear water- Non cohesive material-stable channel carrying sediments-sediment control .

UNIT IV

Bed level variations- continuity equation for sediment – equilibrium depth of scour in long channel contractions- stream bed changes during floods- degradation – aggradations

UNIT V

General mathematical models –silting of reservoirs –local scour- Design of guide bunds and other river training banks.

References:

1. Garde, R.J., “River Morphology”, New International Publishers. 2006

2. Julien, P.Y., “Erosion and Sedimentation”, Cambridge University Press. 1998 3. Jansen, P.P.H., “Principals of River Engineering”, VSSD Publications. 1994

4. Garde, R.J. and Ranga Raju, K.G., "Mechanics of Sediment Transportation and Alluvial Stream Problems", Wiley Eastern Limited. 2006

Course Outcomes

After completion of the course the student will able to

1. Exposure to resistance laws in mobile bed channels/rivers. Scour around bridge piers
2. Design of river protection works

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	2	2	-	2	-		3	-
CO2	2	2	-	2	-		3	-

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPE12 HYDRAULIC STRUCTURES

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

HYDRAULIC STRUCTURES – INTRODUCTION- Types of Hydraulic structures – water retaining structures – water conveying structures. Embankment Dams: Types, design considerations, seepage analysis and control, stabilityanalysis, construction techniques.

UNIT II

GRAVITY DAMS: Forces acting on failure of a gravity dam, stress analysis, elementaryprofile, design of gravity dam, other functional features of a gravity dam.

UNIT III

DAM OUTLET WORKS: Types of outlet structures, ogee spillway, chute spillway, siphonspillway, side channel spillway,.

UNIT IV

TERMINAL STRUCTURES: Hydraulic jump types, stilling basin, roller bucket, ski jump b**asi**n,baffled spillway, drop structure

UNIT V

HYDRAULIC MODELING: Basic principles, dimensional analysis, design of physical models of hydraulic structures.

References:

1. Peterka, A.J, “Hydraulic Design of Stilling Basins and Energy Dissipators”, USBR Engineering Monographs No. 25”. 1984
2. Design of Small Dams", Third Edition, Water Resources Technical Publication – US Bureau of Reclamation. 1987
3. Singh, B., and Varshney, R.S., "Embankment Dam and Engineering", Nem Chand and Brothers. 2004
4. Novak, P. and Nalluri, C., “Hydraulic Structures”, Edition 4, Taylor & Francis. 2007 Creager, Justin and Hinds, “Engineering for Dams”, Vol. I and II, John Wiley.

Course Outcome

1. After completion of the course the student will have the ability toAnalysis and design

of various types of hydraulic structures

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	3	2	-	1	-		3	2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPE13SYSTEMS ENGINEERING

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Definitions and components of a system, system control, systems modelling and modeldevelopment. System synthesis. Economic analysis, conflicts and role of optimization in their resolution.

UNIT II:

Unconstrained optimization – classification – univariate method – Hook-Jeeves pattern search method –powell's search method – Indirect search method – Cauchy's steepest descent method – newton' method.Constrained optimization – elimination method, penality and barrier function method, sequential quadratic programming, mixed integer programming.

UNIT III

Integer programming: Introduction – Integer Linear programming – Graphical Representation – Gomory's cutting plane method (mixed integer programming- sequential discreat programming.Geometric programming: unconstraind geometric programming using differential calculus- arithmetic-geometric inequality

UNIT IV

Linear programming: Geometry of linear programming- Linear simultaneous equation – simplex method- revised simplex method- Duality in linear programming.Dynamic programming- Multistage decision process- concept of sub-optimization and principle and optimality- computational procedure in dynamic programming.

UNIT V

Stochastic programming- Introduction – concept or probability theory – stochastic non-linear programming- geometric programming.

References:

1. Aguilera, R.J., "Systems Analysis and Design", Prentice Hall. 1973
2. Ossenbruggen, P. J., "Systems Analysis for Civil Engineering", John Wiley. 1984
3. Neufrille, R., "Systems Analysis for Engineer" , McGraw Hill. 1971
4. Rao, S.S., "Engineering Optimization – Theory and Practice", New Age International (P) Ltd. 1999
5. Hamdy, A.T., "Operations Research – An Introduction", Prentice Hall. 1997

Course Outcome

1. At the completion of the course the students will be able to understand the system behaviors and know how to apply the various simulation and optimization techniques to achieve optimum utilisation of water resources.

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	-	-	1	3	-		2	1

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPE14HYDRAULIC MODELLING AND EXPERIMENTAL TECHNIQUES

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT – I

HYDRAULIC MODELLING

Hydraulic models - Scale effects - Distorted models - movable bed models - Analogy methods - Design and analysis of experiments - errors in experiments.

UNIT - II

EXPERIMENTAL TECHNIQUES AND MEASUREMENTS

Velocity and pressure measuring Instruments - Pitot cylinder, Pitot sphere, - Anaemometers- Pressure transducers.

UNIT - III

Discharge measuring techniques - Classification of methods - Constriction methods, rotometer - Area-velocity method - Dilution methods and techniques - Special techniques and measuring structures.

UNIT - IV

Measurement of two phase flows - measurement of sediment content in water flows - air-water mixture.Test rigs - Wind and water tunnels - Drag balances.

UNIT - V

Flow visualization techniques- Smoke or dye- Line tracers – oil films – china clay – shadowgraph – direct-shadow method – schlieren method – Interferometer – Examples.

Reference Books :

1. Huntley, H.E. Dover (1967),"Dimensional Analysis"
2. B.B.Sharp (1982), "Hydraulic Modeling" Published by Butter Worths.
3. Troskolousky (1960), "Hydrometry" Pergamon Press, London.
4. Addison, H. Chapman and Hall (1940), "Hydraulic Measurements".
5. Bradshaw, P.(1964), "Experimental Fluid Mechanics", Pergamon Press,
6. Ed. Richard, J. Goldstein, "Fluid Mechanics Measurements" published by

   Hemisphere Publishing Corporation (Distributed by Springer-Verlag).

Course Outcomes (Cos)

Learners should be ableto

1. Able to design the prototype by analyzing the models and applying latest techniques for good efficiency
2. Able to measure the flow in all channels by using latest measurement devices.
3. Able to measure the sediment transport rate in regime flows.

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	2	1	-	1	-		3	-
CO2	2	1	-	1	-		3	-
CO3	2	1	-	1	-		3	-

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPE21WATER RESOURCES SYSTEMS PLANNING

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

INTRODUCTION: Water resources planning process, multi-objective planning.Evaluation of Water Plans: Basic concepts of engineering economics, welfare economics,economic comparison of alternatives.

UNIT II

WATER PLAN OPTIMIZATION: Plan formulation, objective functions and constraint, analyticaloptimization, numerical optimization, linear programming, dynamic programming, simulation, planning under uncertainty.

UNIT III

DETERMINISTIC RIVER BASIN MODELING: Stream flow modeling, estimation of reservoirstorage requirements – dead storage, active storage for water supply/ irrigation / power generation, flood storage, optimal allocation.

UNIT IV

CONJUNCTIVE USE/GROUNDWATER MANAGEMENT MODELS: LP based conjunctive use modeling,aquifer response models, link - simulation, embedded, matrix response based models, soft modeling.

UNIT V

WATER QUALITY MANAGEMENT MODELS: Basic water quality modeling, objectives ofmanagement, control alternatives, optimal plans.

References:

1. Hall, W.A. and Dracup, J.A., "Water Resources Systems Engineering", McGraw Hill Book Company. 1970

2. Loucks, D.P., "Water Resource Systems Planning and Analysis", Prentice Hall. 1981

3. Maass et al., "Design of Water-Resource Systems", Harvard University Press. 1962

4. Vedula S. and Mujumdar, P.P., "Water Resources Systems", Tata McGraw Hill. 2005

Course Outcome

1. Able to use optimum utilization of surface and subsurface water
2. Able to Rational allocation of reservoir water
3. Able to Exposure to various algorithms to solve linear as well as non-linear problems.

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	2	1	-	1	-		3	-
CO2	2	1	-	1	-		3	-
CO3	2	1	-	1	-		3	-

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPE22IRRIGATION AND DRAINAGE

L / week	**: 3Hrs**	**Sessional Marks**	**: 40**
University Exam	**: 3 Hrs**	**End Exam Marks**	**: 60**

UNIT I

Introduction, objectives of irrigation, type of irrigation and suitability; selection ofirrigation method. Irrigation requirement, water balance, soil water relationships, water storage zone,infiltration.

Unit II

Flow of moisture through root zone, soil physical and chemical properties, cropevaporative and drainage requirements, irrigation efficiency and uniformity.

UNIT III

Surface irrigation systems, types of surface systems, basin irrigation, border irrigation,furrow irrigation, field measurement techniques, flow measurement, flumes, weirs, irrigation events, advance, wetting, depletion and recession phases.

UNIT IV

Infiltration, infiltrometer, ponding methods, soil water, tensiometers, neutron probe, timedomain reflectometer, evapotranspiration, crop coefficient, leaf area index, FAO guide lines on evapotranspiration estimation.

UNIT V

Drainage principles, need for drainage, steady state equations, Hooghoudt, Kirkham,Dagan and Ernst equations. Salt balance, water and salt balance of the root zone, salt equilibrium equation andleaching requirement, leaching efficiency.

References:

1. Walker, W.R., and Skogerboe, G.V., "Surface Irrigation Theory and Practice", Prentice Hall, INC. 1987
2. Drainage Principles and Applications, "International Institute for Land Reclamation and Improvement", Wageningen. 1973
3. Michael, A.M., "Irrigation: Theory and Practice", Vikas Publishing House.
4. Asawa, G.L., "Irrigation Engineering", New Age International Publishers.
5. .Majumdar, D.K., “Irrigation Water Management”, PHI Learning. 2009
   6.Luthin, J.N., "Drainage Engineering", John Wiley. 1966
6. Richard H. Cuenea (1989), “Irrigation System Design (An Engineering Approach)” Published by Prentice Hall Inc

Course Outcomes (CO’s)

After completion of course work the students able to

1. Assessment of various soil properties, soil water relationships
2. Measurement of crop water requirements and infiltration
3. Management of salinity problems and leaching process.

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	-	2	1	1	-		2	-
CO2	-	2	1	1	-		2	-
CO3	-	2	1	1	-		2	

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPE23WATER POWER ENGINEERING

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT -1

INTRODUCTION

Sources of energy - Development of water power in India - Advantages and disadvantages of hydropower - Estimation of water power potential- Power house components.

UNIT II

ELECTRICAL LOAD CHARACTERISTICS:

Load curve - Load factor - Capacity factor - Utilization factor - Diversity factor - Load duration curves - Firm power and secondary power load prediction.

UNIT -III

HYDROPOWER PLANTS :

Classification of hydel plants - Runoff river, valley dam, and diversion canal plants - Flow duration curves - Storage and pondage - pumped storage plants - Types - Two unit and three unit arrangements - Efficiency of pumped storage plants - Tidal power plants - Basic principle - Components - Modes of generation - Estimation of energy.

UNIT -IV

WATER CONVEYANCE SYSTEM

Intakes - Types - Hydraulic design of intakes and accessories - power canals - Penstocks - Classification - Design criteria - diameter - Anchor blocks - Design criteria - Water hammer - Surge tanks - Channel surges.

UNIT -V

HYDRAULIC TURBINES:

Selection - Setting of turbines - Cavitation in turbines – Design of Francis turbine- Design of Kaplan turbine – Design of pelton wheel – specific speed of turbine – characteristics curves of turbine.

Reference Books :

1. M.M. Dandekar and K.N.Sharma - Water Power Engineering.
2. Emmil Mosonye - Water Power Development, Vol. I & II.

Course Outcomes (Cos)

1. Able to have knowledge about different sources of energy and electrical load on hydro turbines.
2. Able to understand the concepts of low head, high head and head diversion plants
3. Able to design pumped storage power plants
4. Able to use the concepts of water conveyance
5. Able to plan a power house

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	2	1	-	1	-		3	-
CO2	2	1	-	1	-		3	-
CO3	2	1	-	1	-		3	-
CO4	2	1	-	1	-		3	-
CO5	2	1	-	1	-		3	-

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPE24URBAN HYDROLOGY

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

INTRODUCTION

Urban Hydrology - Need - Highway drainage - Rainfall Characteristics - Point rainfall for Standard Duration - Rainfall and its variability in time and space.

UNIT II

DESIGN STORM PROFILES :

Differences between urban and rural storm profiles - Recommended design procedure - Sensitivity - Storm movement.

UNIT III

FLOOD ESTIMATION :

Planning of field investigations - Measurements; Methods of flood estimation - Regional runoff rainfall model - ORSTOM model - TRRL method - Generalized tropical flood model - Effect of land use - Examples.

UNIT IV

URBAN STORM WATER DRAINAGE:

Design Criteria - Rational method - TRRL hydrograph method - HYDRAON - ILLUDAS (Illinois Urban Drainage Area Simulator) - The Walkingford procedure - The Hydrograph volume method (HVM) - Environmental Protection Agency for Storm Water Management model (SWMM).

UNIT V

PLANNING AND CONTROL MEASURES :

Urban water resources planning - Surface and subsurface drainage - Design of subsurface drains - Erosion Control - Control of Gully erosion - Control of sheet erosion.

REFERENCE BOOK :

"Highway and Urban Hydrology in Tropics" by L.H.Watkins and D. Fiddes, Pentech Publishers (London - plymouth).

Course Outcomes (COs)

After completion of the course the student will have :

1. Able to know about urban rainfall and storm water management in urban areas .
2. Able to design storm water management in urban areas
3. Able to determine the design flood for storm water drainage system.
4. Able to develop urban storm water management models and to suggest suitable erosion control measures.

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	-	3	1	1	-		3	-
CO2	-	3	1	1	-		3	-
CO3	-	3	1	1	-		3	-
CO4	-	3	1	1	-		3	-

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWCP01FLUID MECHANICS LAB

P / week : 4Hrs **Sessional Marks : 40**
University Exam : 3 Hrs **End Exam Marks : 60**

List of Practicals:

1. To study the flow behavior in a pipe bend and to calibrate the pipe bend (i.e., bend or elbow meter) for discharge measurement.
2. To study the boundary layer velocity profile, and to determine the exponent in the power law of velocity distribution, boundary layer thickness and displacement thickness.
3. To study the velocity distribution in a pipe flow and to estimate the energy and momentum correction factors.
4. To study velocity distribution and Reynolds stresses in turbulent flow

Course Outcomes (Cos)

After the completion of course the student must

1. Able to find out surface profiles in forced vortex flow
2. Able to find discharge in elbow meters
3. Able to find energy correction factor , momentum correction factor and hydraulic jump in horizontal and sloping channels.

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	3	1	-	-	-		3	1
CO2	3	1	-	-	-		3	1
CO3	3	1	-	-	-		3	1

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWCP02HYDROLOGY

P / week : 4Hrs **Sessional Marks : 40**
University Exam : 3 Hrs **End Exam Marks : 60**

List of Practicals:

1. Downloading and processing of remote sensing products
2. The hands on experiments in the image processing, GIS platforms
3. Georeferencing of toposheet and creating vector layers(MapInfo/ArcGIS)
4. Creation of attribute tables and layout preparation (MapInfo/ArcGIS)
5. Creation of Digital Elevation Model using Vertical Mapper.
6. GPS Survey and its data transformation into GIS environment.
7. Converting *.tab file to *.shp& vice versa using Universal Translator.
8. Use of D8 pointer algorithm for deriving flow direction, flow accumulation and watershed delineation.

Course Outcomes (Cos)

After the completion of course the student must

1. Able to download the satellite data and it is imported into GIS environment
2. Able to analyse the raster data ,vector data and development of DEM
3. Able to convert GPS data into point data in GIS

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	-	3	1	1	1		2	1
CO2	-	3	1	1	1		2	1
CO3	-	3	1	1	1		2	1

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

PGPA12 DISASTER MANAGEMENT

Instruction Hours/week : 2(L) **Credits : -**

Sessional Marks : 100 **Semester-end Examination : -**

UNIT I

Introduction

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; natural and Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT II

Repercussions Of Disasters And Hazards

Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Manmade disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III

Disaster Preparedness And Management Preparedness

Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT IV

Risk Assessment Disaster Risk

Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

UNIT V

Disaster Mitigation Meaning

Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

References:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.

2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.

3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

Course outcomes :

At the end of the course, students will be able to:

1. demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. develop the standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	-	1	3	1	1		2	1
CO2	-	1	3	1	1		2	1
CO3	-	1	3	1	1		2	1
CO4	-	1	3	1	1		2	1

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

PGMC 41 RESEARCH METHODOLOGY AND IPR

Instruction Hours/week : 2(L) **Credits : 2**

Sessional Marks : 40 **Semester-end Examination : 60**

UNIT I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT II

Effective literature studies approaches, analysis, Plagiarism, Research ethics

UNIT III

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT IV

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT. Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT V

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2nd Edition , “Research Methodology: A Step by Step Guide for beginners”

4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
5. Mayall , “Industrial Design”, McGraw Hill, 1992.
6. Niebel , “Product Design”, McGraw Hill, 1974.
7. Asimov , “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New
9. Technological Age”, 2016.
10. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Outcomes:

At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understand that when IPR would take such important place in growth of individuals & Nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	-	-	-	2	1		-	1
CO2	-	-	-	2	1		-	1
CO3	-	-	-	2	1		-	1
CO4	-	-	-	2	1		-	1
C05	-	-	-	2	1		-	1
CO6	-	-	-	2	1		-	1

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPC03 ADVANCED HYDROLOGY

L / week	**: 3 Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

INTRODUCTION: Hydrologic system and hydrologic budget, fundamental laws of hydrology;atmospheric water vapour. Hydrologic Inputs: Precipitation and its forms, snowfall and rainfall; measurementtechniques and space-time characteristics

UNIT II

HYDROLOGIC ABSTRACTIONS: Infiltration, depression storage, evapotranspiration;measurement techniques, space time characteristics and their modelling.

UNIT III

STREAM FLOW: Measurement techniques, space-time characteristics, rating curves System Approach: Unit Hydrograph IUH, Clark and Nash model.

UNIT IV

MATHEMATICAL MODELLING: Linear and Nonlinear models, Physically based models Hydrological routing, Flood forecasting

UNIT V

ADVANCED METHOD OF FREQUENCY ANALYSIS: Outliers, Time series analysis. Impact of climate change and Land use/Land cover on basin response

References:

1. Chow, V.T., Maidment, D.R. and Mays, W.L., "Applied Hydrology", McGraw Hill. 1988
2. Ojha, C.S.P., Berndtsson, R. and Bhunya, P., “Engineering Hydrology”, Oxford University Press. 2008
3. Wanielista, M., Kersten, R. and Eaglin, R., “Hydrology”, John Wiley. 1997

Course Outcomes (Cos)

After the completion of course the student must

1. To develop basic tools for analysis of hydrologic processes
2. To apply the knowledge of time series models for hydrologic data generation and forecasting.

3. To be familiar with the hydrologic design concepts and methods including estimation of the design flows
4. To assess impact of climate change and Land use/Land cover on water availability

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	-	2	1	1	-		3	2
CO2	-	3	1	1	-		3	2
CO3	-	3	1	1	-		3	2
CO4	-	3	2	1	-		3	2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPC04GROUNDWATER ENGINEERING

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

INTRODUCTION

Definition of groundwater, role of groundwater in hydrological cycle,groundwater bearing formations, classification of aquifers, flow and storage characteristics of aquifers, Darcy's law, anisotropy and heterogeneity. Governing Equations for Groundwater Flow: Dupuit-Forchheimer assumptions, generaldifferential equations governing groundwater flows, analytical solutions.

UNIT II

WELLS AND WELL HYDRAULICS

Different types of wells, construction of wells, steady andunsteady state solutions for confined, unconfined and leaky aquifers, effect of boundaries, method of images, pumping test analysis. Groundwater Conservation: Regional groundwater budget; resource assessment;estimation of recharge, Indian practice for artificial recharge

UNIT III

GROUNDWATER QUALITY

General problem of contamination of groundwater, sources,remedial and preventive measures, seawater intrusion in coastal aquifers.

UNIT IV MANAGEMENT OF GROUNDWATER

Concept of basin management – Equation of Hydrologic Equilibrium – Groundwater basin investigations – Data collection and field work – Alternative basin yields – Evaluation of perennial yield – salt balance – basin management by conjunctive use

UNIT IV

GROUNDWATER FLOW MODELLING

Role of groundwater flow models, reference to hydraulic,Hele-Shaw and analog models, introduction to numerical modeling.

References:

1. Todd, D.K., "Groundwater Hydrology", John Wiley. 1959
2. Bear, J., "Hydraulics of Groundwater", McGraw. 1979
3. Bouwer, H., "Groundwater Hydrology", McGraw Hill. 1978
4. Walton, W.C., "Groundwater Resources Evaluation", McGraw Hill. 1970 Freeze and Cherry, "Groundwater", Prentice Hall. 1979
5. Driscoll, F.G., "Ground Water and Wells", Johnson Division. 1986
6. Raghunath, H. M., "Ground Water", New Age International (P) Limited.

Course Outcomes (Cos)

After the completion of course the student must able to

1. To understand aquifer properties and movement of ground water flow after the completion of the course.
2. Able to exposure towards well design and practical problems of ground water aquifers.
3. Able to find out groundwater quality parameters
4. Able to manage the groundwater resources

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	-	2	1	2	-		3	2
CO2	-	2	1	2	-		3	2
CO3	-	2	1	2	-		3	2
CO4	-	2	1	2	-		3	2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPE31COMPUTATIONAL METHODS IN FLUID MECHANICS

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Review of numerical techniques like method of characteristics, finite difference method.

Finite element method- Finite element formulation – interpolation function – one dimensional element – two dimensional elements – three dimensional elements.

UNIT II

Causes of transients in pipes, water hammer, rigid water column theory, elastic water column theory, equivalent bulk modulus of elasticity.

UNIT III

Transient open channel flow: Introduction- Examples of transient flow – Governing equation – methods of solution – method of characteristics –Explicit and implicit Finite difference method.

UNIT IV

Numerical solutions for Navier-Stokes, boundary layer and Reynolds equations.

UNIT V

Groundwater modeling, formulation of anisotropic and non homogenous flow of groundwater, finite difference methods for solving groundwater flow problems, regional groundwater flow modelling.

References:

1.Anderson, "Computational Fluid Mechanics and Heat Transfer", McGraw Hill. 1984
2. Chung, T. J., "Finite Element Analysis in Fluid Dynamics", McGraw Hill. 1978
3.Anderson, &Weessner, "Applied Groundwater Modelling", Academic Press. 1992

4.Chaudhary, H. M., "Applied Hydraulic Transient", McGraw Hill. 1976

5. Streeter and Wylie, "Fluid Transients", McGraw Hill. 1976

6. Smith, G.D., "Numerical Solution of Partial Differential Equations-FDM". 1985
7. M. Hanif Chaudhry " Applied Hydraulic transients" third edition, springer publications

Course Outcomes

1. Able to compute the various flow parameters using FDM

2. able to analyse the flow field in a variety of practical situation without going for physical

model setup

3. Able to solve the groundwater flow modelling conditions.

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	2	1	-	1	-		2	2
CO2	2	1	-	1	-		2	2
CO3	2	1	-	1	-		2	2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPE32THEORY AND APPLICATIONS OF GIS

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

INTRODUCTION, Geographical concepts and Terminology, Difference between ImageProcessing system and GIS, Utility of GIS. Various GIS packages and their salient features, Essentials components of GIS, Dataacquisition through scanners and digitizers.

UNIT II

RASTER AND VECTOR DATA: Introduction, Descriptions: Raster and Vector data, RasterVersus Vector, Raster to Vector conversion, Remote Sensing Data in GIS, Topology and Spatial Relationships, Data storage verification and editing.

UNIT III

DATA PRE-PROCESSING, Georeferencing, Data compression and reduction techniques,Run length encoding, Interpolation of data, Database Construction, GIS and the GPS, Data Output Database structure, Hierarchical data, Network systems, Relational database, Database management, Data manipulation and analysis

UNIT IV

SPATIAL AND MATHEMATICAL OPERATIONS IN GIS, Overlay, Query based, Measurement andstatistical modelling, Buffers, Spatial Analysis, Statistical Reporting and Graphing Programming languauges in GIS, Virtual GIS, Web GIS

UNIT V

APPLICATION OF GIS IN WATER RESOURCES : Land use/Land cover, Rainfall – Runoff relations and runoff potential indices of watersheds, Flood and Drought impact assessment and monitoring. Watershed management for sustainable development and Watershed characteristics – Reservoir sedimentation, Identification of suitable sites for Ground water & identification of sites for artificial recharge structures, Drainage morphometry, water depth estimation

References:

1. Burrough, P.A. and Mc Donnel, R.A., “Principles of Geographic Information System”,

Oxford University Press. 2000.

2. Chrisman, Nicholas R., “Exploring Geographic Information Systems”, John Wiley. 2002

3. Demers, Michael N., “Fundamentals of Geographic Information System”, 2nd Ed. Wiley. 2008

4. Ghosh, S.K. and Chandra, A.M., “Remote Sensing and GIS”, Narosa Publishing House. 2008

5. Lo, C.P. and Young, A.K.W., “Concepts and Techniques of Geographical Information System”, Prentice Hall India. 2002

6. Longley, Paul A, Goodchild, Michael F., Maguire, David J. and Rhind, David W., “Geographic Information Systems and Science”, Wiley. 2001.

Course Outcomes

1. Able to analyse the data both in raster format and vector format

2. Able to evaluate the performance of irrigation systems

3. Able to evaluate groundwater potential using GIS and various applications in water resources engineering.

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	-	2	1	1	-		3	2
CO2	-	2	1	1	-		3	2
CO3	-	2	1	1	-		3	2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPE33HYDROGEOLOGY AND GEOPHYSICAL EXPLORATION OF GROUNDWATER

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT-I

INTRODUCTION :

Definitions of Hydrogeology – Interdisciplinary subject - Exploration of ground water – Aquifer properties - Porosity, permeability and hydraulic head- Direction and speed of movement of groundwater.

UNIT-II

GROUNDWATER IN DIFFERENT ROCK FORMATIONS

Rock types – Yield of groundwater from Igneous, metamorphic, sedimentary rocks, coastal deposits and glacial deposits - Groundwater indicators – Reservoir indicators – Surface indicators – Boundary indicators

UNIT – III

METHODS OF EXPLORATION- 1

Theory of electrical resistivity - Sounding and profiling - Four electrode system – Wenner and Sclumberger configuration-Cumulative resistivity method – Tagg's master curves. Electrical logging - Spontaneous potential logging - Interpretation from logs.

UNIT – IV

METHODS OF EXPLORATION - 2

Types of waves- elastic constants – Refraction method of measurement – its interpretation - Reflection method of measurement – its interpretation.Soil temperature survey – Magnetic survey – Gravity survey.

UNIT – V

METHODS OF EXPLORATION- 3

Application of Remote sensing method to delineate groundwater potential zones- thematic maps – Assessment of status of groundwater development.Radioactive logging , Induction logging,

sonic logging- interpretation from logs.Drilling time, factors influencing and use of drilling time, applications of drill stem test data, wire line formation test.

Reference Books:

1. Raghunath H M (1998) “Groundwater” New Age International Publishers
2. Davis S.N. and Dewiest R.I.M. (1967) ”Hydrogeology” – John Wiley sons.
3. Griffith,D.H and King R.F (1966) “Applied geophysics for Engineers and geologists” Pergamen Press.
4. Todd,D.K. (1980) “Groundwater Hydrology” John Wiley and sons, New York.
5. R.Kirsch (edited by) “ Groundwater Geophysics- A tool for hydrogeology” 2nd edition, Springer Publications.

Course Outcomes (COs)

After completion of the course the student will have :

1. Able to identify different types of aquifers
2. Able to find out yield of well in different aquifers
3. Able to conduct geophysical exploration studies on groundwater identification studies
4. Applying different logging techniques in groundwater and remote sensing and gis

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1		2	2	1	-		3	-
CO2		2	2	1	-		3	-
CO3		2	2	1	-		3	-
CO4		2	2	1	-		3	-

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPE34COASTAL ENGINEERING

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT -I

COASTAL ZONE PROCESS:

General, Sediment properties; measurement and sampling techniques - fundamental principles of movement - bad load and suspended load transport.

UNIT -II

Role of coastal sedimentation process - Long shore drift - Beach Evaluation Models - General sediment transport models - On-shore and off-shore sediment transport.

UNIT -III

Beach nourishment - Coast and Bed Morphology - Regime of the Coast and Sea Beach - Sand features - Features of Estuaries - Coastal and Beach features.

UNIT –IV

COASTAL PROTECTION

Identification of the problem - Restoration of the Beach - Groynes and Rivetments - Off-shore Breakwaters, Bays and Artificial Headlands - Beach replenishment.

UNIT -V

DESIGN PRINCIPLES OF COASTAL AND HARBOUR STRUCTURES :

Break water - types - Waves, Jelties and Piers; Docks - different types.

Reference Books :

1. "Coastal Hydraulics" (2nd Edn) By A.M. Muir Wood and CA Fleming, John Wiley and Sons (Newyork).
2. "Coastal Engineering" (Vol. 1 & 2) by Richard L. Silvister, Elsvier Scientific Publishing Company.

Course Outcomes (Cos)

1. Able to know Explain the properties, measurement and principles of sediment transport.

2. Able to evaluate the different sediment transport models

3. Able to describe the different features of coast and beach

4. Able to apply the knowledge of design principles of coastal and harbor structures

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	1	2	1	1	-		3	1
CO2	1	2	1	1	-		3	1
CO3	1	2	1	1	-		3	1
CO4	1	2	1	1	-		3	1

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPE41 ENVIRONMENTAL HYDRAULICS

L / week : 3Hrs **Sessional Marks : 40**
University Exam : 3 Hrs **End Exam Marks : 60**

UNIT I

Introduction and scope, review of basic principles of engineering fluid mechanics,continuity, momentum, and energy equations, steady flow through pipes-hydraulic gradient and total energy line, basics of open channel flow; Ground water, well hydraulics, well design and constructions,

UNIT II

Parallel, compound and equivalent pipes, head losses in pipes, design of pressurizedconduits,

UNIT III

Various forms of mixing in the environment, modeling of the mixing process:

advection dispersion equation, Various forms of advection dispersion eq. and its solution.

UNIT IV

Special cases of mixing, density stratified flow, tide, etc.

UNIT V

Mass transfer in gas-liquid and liquid -liquid system with special emphasis onaeration,
Project presentation

References:

1. Roberson, J.A., Cassidy, J.J., Chaudhry, M.H. “Hydraulic Engineering”, 2nd Edition, Wiley. 1998
2. Chadwick, A., Morfett, J., Borthwick, M. “Hydraulics in Civil and Environmental Engineering”, 5th Edition, CRC Press. 2004
3. Lee, C. C., Lin, S.D. “Handbook of Environmental Engineering Calculations”, McGraw Hill. 2007
4. Schnoor, J.L., Environmental Modeling: Fate of Chemicals in Water, Air and Soil, John Wiley & Sons, New York. 1996.

Course Outcome

1. The students will be able to gain a basic knowledge of advection-dispersion processes in the environment.

2. Able to gain the skills to take up research activities in solving environmental problems involving fluid motions.

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	2	1	-	1	-		2	-
CO2	2	1	-	1	-		2	-

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPE42 ADVANCED NUMERICAL ANALYSIS

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Introduction to digital computers & Programming an overview; Errors-Polynomial approximations and interpolations-Numerical differentiation & Integration.

UNIT II

Evaluation of single and multiple integrals, Newton's method, variational and weightened residual methods.

UNIT III

Matrices –Linear equations, Eigenvalues and Eigenvectors-nonlinear equations,

UNIT IV

Harmonic and biharmonic equations - solutions, convergence, completeness & stability.

UNIT V

Initial and boundary value problems of finite difference method, Implicit & Explicit scheme.

References

1.Jain M.K, SRK Iyenge and RK Jain."Numerical Methods for Scientific & Engg. Computation".

2.Mathews J. H "Numerical Methods for Mathematics, Science and Engineering".

3.Gerld C.F and PO Wheatley "Applied Numerical Analysis".

4. Gupta S.C and V. K. Kapoor "Fundamentals of Applied Statistic", Sultan Chand & Sons.

5. Johnson R.A " Probability and Statistics for Mngineers.

Course outcomes:

1.able to determine different variables using different numerical techniques.

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	-	1	2	1	-		-	1

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPE43RIVERWATER MANAGEMENT

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT -1

INTRODUCTION

Planning and analysis of Water Resources Systems –Probability concepts and methods.

UNIT -II

WATER RESOURCES PLANNING UNDER UNCERTAINITY

Distributions of random events - Stochastic process and time series - Planning with uncertainity - analysing systems with dynamic uncertainty.

UNIT -111

DETERMINISTIC RIVER BASIN MODELLING:

Food control alternatives - Hydro power production - Withdrawals and Diversions - Model synthesis -Expansion of water resources systems.

UNIT -IV

SYNTHETIC STREAM FLOW GENERATION:

Statistical streamflow generation models - Multisite models - Multiseasonal models - Model selection and parameter estimation - Stream flow generation from precipitation data.

UNIT -V

STOCHASTIC RIVER BASIN PLANNING MODELS

Reservoir operation - Single reservoir design and operation - Multiple - Site River Basin Planning Models.

Reference Books :

1. “Water Resources System Planning and Analysis” by Daniel P.Loucks, Jerry R.

   Stedinger and Douglass A. Haith (Published by Prentice - Hall Inc.)

Course outcomes:

1. Able to plane water resources projects with different uncertainties

2. Able to design the river basing modelling

3. Able to design the stochastic river basin planning models

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	-	3	2	1	-		3	-
CO2	-	3	2	1	-		3	-
CO3	-	3	2	1	-		3	-

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPE43THEORY OF SEEPAGE AND GROUNDWATER MOVEMENT

L / week : 3Hrs **Sessional Marks : 40**
University Exam : 3 Hrs **End Exam Marks : 60**

UNIT I

MOVEMENT OF GROUNDWATER

Darcy's flow - Range of validity of Darcy's law - permeability coefficient – laboratory and field methods of measurement - General hydrodynamic equation.

UNIT II

STEADY STATE FLOWS

Bboundary conditions – flow nets – construction and analysis of flow nets – flow nets for anisotropic soils.

UNIT III

UNCONFINED FLOWS

Dupuit's theory of unconfined flow – basic considerations- Two-dimensional flow on a horizontal impervious boundary - Free surface subjected Infiltration and Evaporation - groundwater flow with an inclined lower impervious boundary – Pavlosky's solutions.

UNIT IV
CONFORMAL TRANSFORMATIONS AND MAPPING TECHNIQUES

Geometrical representation of w = f(z) and z = f(w), application of the mapping function $z = w^2$ - Reciprocal function w = 1/z - Velocity hodograph – impervious boundary – boundary of reservoir – surface of seepage –free surface– flow characteristics at singular points of flow domain – example of velocity hodograph.

UNIT V
RECHARGE OF GROUNDWATER

Concept of recharge – methods- waste water recharge for reuse – Artificial recharge for energy purposes.

References :

1. Groundwater and Seepage : M.E. Harr ,Mc Graw Hill pubs.
2. Ground water Hydrology : D.K. Todd, John Wiley & Sons

Course Outcomes (Cos)

1. Able to know about movement of groundwater
2. Able to apply the boundary conditions and flow net analysis of groundwater
3. Able to apply the principles of unconfined flow and infiltration flow of groundwater
4. Able to apply conformation transformation of mapping of groundwater
5. Able to analyze different subsurface investigations and artificial recharge techniques

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	-	3	1	1	-		3	-
CO2	-	3	1	1	-		3	-
CO3	-	3	1	1	-		3	-
CO4	-	3	1	1	-		3	-
CO5	-	3	1	1	-		3	-

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWCP03Computational Fluid Dynamics

P / week : 4Hrs **Sessional Marks : 40**
University Exam : 3 Hrs **End Exam Marks : 60**

List of Practicals

Exposure to software's such as ANSYS, FLUENT, creation of Geometry, Mesh, description of boundary condition and solution of flow problems in 1D, 2D and 3D. typical examples should include flow around sphere, cylinders, bridge piers etc.

Course Outcomes:

1. Able to find out boundary flow condition solution flow in 1D, 2D and 3D flows using software ANSYS, FLUENT

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	3	2	1	1	1		3	2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWCP04OPEN CHANNEL FLOW

P / week : 4 Hrs **Sessional Marks : 40**
University Exam : 3 Hrs **End Exam Marks : 60**

List of Practicals:

1. To calibrate a broad-crested weir and study the pressure distribution at the upstream end of the weir.
2. To study the characteristics of a hydraulic jump.
3. To study the velocity distribution downstream of an expansion (with and without splitter plates) in a channel.
4. To obtain pressure distribution over spillway profile
5. To study energy dissipation using baffle blocks
6. To study air entrainment in open channel flow
7. To study the velocity distribution in an open channel and to estimate the energy and momentum correction factors.

Course outcomes:

1. Able to find out pressure distributions of the weir

2. Able to determine velocity distribution and pressure distribution in channels

3. Able to find out kinetic energy correction factor , momentum correction factor on horizontal and sloping channels.

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	2	1	1	1	1		3	-
CO2	2	1	1	1	1		3	-
CO3	2	1	1	1	1		3	-

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPA02 Audit course II

PGPA 21 CONSTITUTION OF INDIA

Instruction Hours/week : 2(L) **Credits : -**

Sessional Marks : 100 **Semester-end Examination : -**

Course Objectives:

Students will be able to:

1. understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I

History and philosophy of the Indian Constitution

History -Drafting Committee, (Composition & Working) - Preamble - Salient Features

UNIT II

Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT III

Organs of Governance: Parliament – Composition - Qualifications and Disqualifications - Powers and Functions, Executive President – Governor - Council of Ministers - Judiciary, Appointment and Transfer of Judges, Qualifications - Powers and Functions

UNIT IV

Local Administration:

District's Administration Head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI:

ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT V

Election Commission: Election Commission: Role and Functioning - Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

At the end of the course, students will be able to discuss

1. the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. the passage of the Hindu Code Bill of 1956.

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	-	-	-	2	1		-	-
CO2	-	-	-	2	1		-	-
CO3	-	-	-	2	1		-	-
CO4	-	-	-	2	1		-	-

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWP01 MINI PROJECT

Instruction Hours/week : 2(L) **Credits : 2**

Sessional Marks : 100 **Semester-end Examination : -**

Syllabus Contents:

Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution.

Continuous assessment of Mini Project at Mid Semester and End Semester will be monitored by the departmental committee.

Course Outcomes: At the end of the course, the student will be able to:

1. Identify Water resources engineering problems reviewing available literature.
2. Study different techniques used to analyze water resources systems.
3. Work on the solutions given and present solution by using his/her technique applying engineering principles.

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	-	1	2	2	3		3	1
CO2	-	1	2	2	3		3	1
CO3	-	1	2	2	3		3	1

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPE51 COMPUTER METHODS IN HYDRAULICS AND HYDROLOGY

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

BASIC: Introduction to computer programming and computation with Matlab.

UNIT II

OPEN CHANNEL FLOW: Estimation of normal and critical depth; uniform flow computations;computation of water surface profile (WSP) - gradually varied flow estimation using standard step and direct step methods, WSP in presence of hydraulic structures; unsteady flow - Saint-Venant equation, kinematic wave routing, diffusion routing, overland flow; steady and unsteady modelling using HEC-RAS.

UNIT III

GROUNDWATER HYDROLOGY: Solving groundwater flow equation - saturated and unsaturatedflow, Richards' equation, Green-Ampt infiltration model; introduction to MODFLOW.

UNIT IV

SURFACE WATER HYDROLOGY: Estimation of Unit hydrographs; lumped and distributed flowrouting; hydrologic statistics - parameter estimation, time series analysis, frequency analysis, geostatistics; hydrologic modelling using HEC-HMS/SWAT.

UNIT V

CLOSED CONDUIT FLOW: Steady and unsteady state modeling; pipe network analysis;introduction to EPANET. Application of soft computing methods and GIS in Hydraulic and Hydrologic modeling.

References:

1. Chow V.T., Maidment D.R. and Mays L.W. (1988), Applied Hydrology, McGraw-Hill. 1988

2. Todd D.K. and Mays L.W. (2008), Groundwater Hydrology, 3rd Edition, John Wiley & Sons. 2008

3. Chaudhry M.H. (2007), Open-Channel Flow, 2nd Edition, Springer, 2007
Pratap R. (2010), Getting started with Matlab, Oxford. 2010

4. P.K. Swamee and Sharma A.K. (2008), Design of water supply pipe networks, John Wiley & Sons. 2008

Course Outcomes (Cos)

After the completion of course the student must able to

1.Apply the computational knowledge in the field of water resources systems

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	1	3	2	1	-		3	1

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPE52STOCHASTIC HYDROLOGY

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT - I

STOCHASTIC PROCESSES :

Description - Classification - Stationarity - Persistance - Tests - Time series - Classification - Components - Trend - Cyclic and Stochastic Components - Methods of Investigation.

UNIT - II

AUTOCORRELATION ANALYSIS

Autocorrelation coefficients - Correlogram - Moving Average and Auto-regressive processes (First order and second order).

UNIT - III

SPECTRAL ANALYSIS

Line spectrum- continuous spectrum-Spectral density function for an Independent process – Spectrum of a moving average process-Spectrum of an autoregressive process.

UNIT - IV

SYNTHETIC FLOW GENERATION MODELS

Classification - Single site annual models - First order and second order AR models – Seasonal Models – Thomas-Fiering and Rosener and yevjevich models.

UNIT - V

GENERATION OF RANDOM NUMBERS

Uniformly distributed random numbers - Normal random numbers - Random numbers of other distributions.

Reference Books :

1) H.M.Raghunath, “Hydrology”.

2) R.S.Varshney, “Engineering Hydrology”.

3) Mutreja, “Applied Hydrology”.

4) P.Jayarami Reddy, “Stochastic Hydrology”.

5) V.Yevjevich, “Stochastic Processes in Hydrology”.

Course Outcomes (Cos)

1. Able to analyze the uncertainty in data by using stochastic hydrology
2. Able to find statistical analysis of hydrological data by auto regression analysis
3. Able to find out synthetic generation model and generation of random numbers

--oOo—

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	-	3	2	1	-		3	-
CO2	-	3	2	1	-		3	-
CO3	-	3	2	1	-		3	-

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPE53 WATERSHED MANAGEMENT AND MODELLING

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT -I

WATERSHEDMANAGEMENT-I:

Basin characteristics - Classification of effective watershed management methods - Factors affecting integrated watershed management - Watershed inventory.

UNIT -II

WATERSHED MANAGEMENT II :

Problem definition and scope - Consultation process - Developing workable management options - Evaluation of constraints and criteria - Simple assessment methods.

WATERSHED MODELLING I :

Runoff components- correlation coefficient, linear regression- least square's method, coefficient of determination, t-and F-test; Types of model- black box, parametric and physically based;cuvillinear relations, multi-linear regression model.

UNIT -III

WATERSHED MODELLING II :API & wetness performance, calibration, validation, errors, coefficient of efficiency and other tests, graphical methods. Simple parametric models- Curve Number Method, its modification, variable source area models; quasi- physically based models; a simple physically based model.

UNIT -1V

SOIL CONSERVATION:

Soil loss estimation - Universal soil loss equation; soil erosion principles - Gulley erosion - Design of permanent gully control structures - Stream bank erosion - Erosivity and erodability, Engineering measures to control erosion - Terracing, bunding, vegitated waterways. Wind erosion and control practices.

UNIT –V

ARTIFICIAL GROUNDWATER RECHARGE TECHNIQUES AND WATER HARVESTING TECHNIQUES:

Artificial recharge - Considerations - Methods - Induced Infiltration - Water Spreading - Flooding - Artificial recharge basins and distches - Natural channel modifications - Recharge pits and shafts - Recharge wells. Farm ponds- Percolation tanks.

Reference Books :

1. Prof. R.Suresh, "Watershed Hydrology" Standard Publishers.
2. Isobel W. Heathiote."Integrated Watershed Management - Principles & Practices".
3. Schwab, G.O. & Others, "Soil and Water Conservation Engg."
4. Prof.R.Suresh, "Soil and Water Conservation Engg.",

   (Standard Publishers).
5. Wayne A. Pettyjohu, "Introduction to Artificial Ground Water Recahrge" Scientific

   Publishers, Jodhpur.
6. Murthy J.V.S., "Wastershed Management".

Course outcomes:

1. Able to use watershed management methods and optimization techniques
2. Able to apply soil conservation equation and principles
3. Able to use water harvesting techniques and artificial recharge techniques

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	-	3	2	1	-		3	-
CO2	-	3	2	1	-		3	-
CO3	-	3	2	1	-		3	-

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPE54CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

EARTH'S CLIMATE SYSTEM: Introduction-Climate in the spotlight - The Earth's Climate Machine – Climate Classification - Global Wind Systems – Trade Winds and the Hadley Cell – The Westerlies - Cloud Formation and Monsoon Rains – Storms and Hurricanes – The Hydrological Cycle – Global Ocean Circulation – El Nino and its Effect - Solar Radiation –The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.

UNIT II

OBSERVED CHANGES AND ITS CAUSES: Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC –Evidences of Changes in Climate and Environment – on a Global Scale and in India – climate change modeling.

UNIT III

IMPACTS OF CLIMATE CHANGE: Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions– Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

UNIT IV

CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES: Adaptation Strategy/Options in various sectors – Water – Agriculture –- Infrastructure and Settlement including coastal zones – Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS)- Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.

UNIT V

CLEAN TECHNOLOGY AND ENERGY: Clean Development Mechanism –Carbon Trading- examples of future Clean Technology – Biodiesel – Natural Compost – Eco-Friendly Plastic –

Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydropower – Mitigation Efforts in India and Adaptation funding.

Course outcomes:

At the end of the course the students will able to

1. Identify factors influencing the global climate systems
2. Assess impacts of climate change on global, regional and local scales
3. Develop strategies for adaptation and mitigation measures
4. Identify clean technologies for sustainable development

References:

1. Anil Markandya , Climate Change and Sustainable Development: Prospects for Developing Countries, Routledge, 2002

2. Heal, G. M., Interpreting Sustainability, in Sustainability: Dynamics and Uncertainty, Kluwer Academic Publ., 1998

3. Jepma, C.J., and Munasinghe, M., Climate Change Policy – Facts, Issues and Analysis, Cambridge University Press, 1998

4. Munasinghe, M., Sustainable Energy Development: Issues and Policy in Energy, Environment and Economy: Asian Perspective, Kleindorfor P. R. et. al (ed.), Edward Elgar, 1996

5. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	-	3	2	1	-		1	-
CO2	-	3	2	1	-		1	-
CO3	-	3	2	1	-		1	-
CO4	-	3	2	1	-		1	-

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

Open Elective- I

HWOE12 INDUSTRIAL SAFETY

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV

Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of

electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

References

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Course Outcomes

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	-	1	2	1	-			2
CO2	-	1	2	1	-			2
CO3	-	1	2	1	-			2
CO4	-	1	2	1	-			2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

HWPD01 DISSERTATION I

P / week : 20 Hrs **Sessional Marks :100**

University Exam : NIL **End Exam Marks :**

Syllabus Contents:

Dissertation-I will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions and must bring out individuals contribution.

Continuous assessment of Dissertation – I and Dissertation – II at Mid Semester and End Semester will be monitored by the departmental committee.

Course Outcomes: At the end of the course, the student will be able to:

1. Identify Water resources engineering problems reviewing available literature. Identify appropriate techniques to analyze complex structural systems.
2. Apply engineering and management principles through efficient handling of project

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	-	2	3	2	3		3	2
CO2	-	2	3	2	3		3	2
CO3	-	2	3	2	3		3	2
CO4	-	2	3	2	3		3	2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly**

HWPD02 DISSERTATION II

P / week : 32 Hrs **Sessional Marks :40**

University Exam : NIL **End Exam Marks : 60**

Syllabus Contents:

Dissertation – II will be extension of the to work on the topic identified in Dissertation – I.

Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc. There will be pre-submission seminar at the end of academic term. After the approval the student has to submit the detail report and external examiner is called for the viva-voce to assess along with guide.

Course Outcomes: At the end of the course, the student will be able to:

1. Solve complex Water Resources problems by applying appropriate techniques and tools.

2. Exhibit good communication skill to the engineering community and society.

3. Demonstrate professional ethics and work culture.

PO&PSO / CO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	-	2	3	2	3		3	2
CO2	-	2	3	2	3		3	2
CO3	-	2	3	2	3		3	2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly**

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING DEPARTMENT OF CIVIL ENGINEERING

M.Tech Degree Program (CBCS)

Curriculum & Syllabi for Environmental Engineering

(w.e.f 2018-19)

MAY, 2018

PROGRAMME EDUCATIONAL OBJECTIVES

1. To Pursue professional career in Public or Private Sectors and demonstrate skills required to take up environmental challenges.

2. To Pursue research in reputed organizations.

3. To take up consultancy for design, execution and management of environmental engineering related projects

4. To inculcate in programme graduates of sensitivity towards social and corporate responsibilities for providing sustainable solutions to the Civil Engineering Problems.

PROGRAMME OUTCOMES (POs)

1. Students will able to analyze water quality, wastewater characteristics, air quality and solid waste characteristics through various laboratory tests.
2. Students can design water treatment plants, wastewater treatment plants, air pollution control systems and scientifically manage solid waste.
3. Student can carryout research work related to civil and environmental engineering related projects.
4. Students can able to Develop civil engineering solutions based on societal, health, safety, legal, cultural and environmental considerations for sustainable development.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1. To prepare programme graduates with fundamental concepts to perform analysis and design various treatment plants underlying in the field of environmental engineering.
2. To develop an interest in programme graduates towards research work in the relevant domains for providing sustainable solutions to the Civil Engineering Problems.
3. To prepare programme graduates to Work effectively as an individual or in diversified and multidisciplinary environments showing the team solidarity.

M. Tech (ENVIRONMENTAL ENGINEERING) – I Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
EEPC01	Advanced Water Treatment	3	-	-	3	3	40	60	100
EEPC02	Air Pollution and Control	3	-	-	3	3	40	60	100
Professional Elective- I Any One from the Following		3	-	-	3	3	40	60	100
EEPE11	Environmental Chemistry								
EEPE12	Environmental Quality and Pollution Monitoring Techniques								
EEPE13	Rural Water Supply and Onsite Sanitation System								
EEPE14	Ecological Engineering and Stream Ecology								
Professional Elective- II Any One from the following		3	-	-	3	3	40	60	100
EEPE 21	Environmental Microbiology								
EEPE 22	Noise Pollution and Control								
EEPE 23	Ground Water Contamination								
EEPE 24	Transport of Water and Wastewater								
EECP 01	Environmental Engineering Lab - I	-	-	4	4	2	40	60	100
EECP 02	Environmental Engineering Lab – II	-	-	4	4	2	40	60	100
EEPA 01	Audit Course – I	2	-	-	-	-	-	-	-
PGPC 41	Research Methodology and IPR	2	-	-	-	2	40	60	100
	Total	16	-	8	20	18	280	420	700

M. Tech (ENVIRONMENTAL ENGINEERING) – II Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
EEPC03	Advanced Wastewater Treatment	3	-	-	3	3	40	60	100
EEPC04	Municipal Solid Waste Management	3	-	-	3	3	40	60	100
Professional Elective- III Any One from the Following		3	-	-	3	3	40	60	100
EEPE 31	Industrial Wastewater Treatment								
EEPE32	Urban Water Management								
EEPE33	Hazardous Waste Management								
EEPE34	Wastewater Reclamation and Reuse								
Professional Elective- IV Any One from the Following		3	-	-	3	3	40	60	100
EEPE 41	Environmental Impact Assessment								
EEPE 42	Sustainable Engineering and Technology								
EEPE 43	Bioremediation								
EEPE 44	Environmental Legislation and Audit								
EECP 03	Environmental Modeling Lab	-	-	4	4	2	40	60	100
EECP 04	Unit Operations and Processes laboratory	-	-	4	4	2	40	60	100
EEPA 02	Audit Course-II	2	-	-	-	-	-	-	-
EEMP 01	Mini Project	2	-	-	-	2	100	-	100
	Total	16	-	8	20	18	340	360	700

M. Tech (ENVIRONMENTAL ENGINEERING) – III Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Professional Elective- V Any One from the Following		3	-	-	3	3	40	60	100
EEPE51	Clean Technology								
EEPE52	Mathematical Modeling in Environmental Engineering								
EEPE53	Environmental Management								
EEPE54	Climate Change								
Open Elective- I Any One from the Following		3	-	-	3	3	40	60	100
EEOE 11	Business Analysis								
EEOE 12	Industrial Safety								
EEOE 13	Operations Research								
EEOE 14	Cost Management of								
EEOE 15	Composite Materials								
EEOE 16	Energy Generation from Waste								
EEPD 01	Major project: Phase-I Dissertation	-	-	20	20	10	100	-	100
Total		6	-	20	20	16	180	120	300

M. Tech (ENVIRONMENTAL ENGINEERING) – IV Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
EEPD 02	Major Project: Phase – II Dissertation	-	-	32	32	16	40	60	100
Total		-	-	32	32	16	40	60	100

SEMESTER-I

EEPC01 ADVANCED WATER TREATMENT

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT –I

WATER QUALITY AND CRITERIA: Water quality criteria and standards for different uses-drinking, irrigation, industrial and construction. Water quality indices, physical, chemical and physicochemical unit operations and processes -Typical treatment flow sheet of surface and underground water.

AERATION: Aeration, solubility of gases-two film theory, aeration methods, design of different aeration systems-sprinkler, cascade and mechanical.

UNIT –II

SEDIMENTATION: Different types of settling, settling column analysis, settling velocity and design principles of sedimentation tank, Tube settlers.

COAGULATION AND FLOCCULATION: Theory and mechanism of chemical coagulation and flocculation, determination of optimum coagulant doses, Chemical feed system. Theory of flocculation – orthokinetic and perikinetic, G and Gt factor, Hydraulic and mechanical mixing arrangements, design of different types of flash mixing and flocculator units.

UNIT –III

FILTRATION : Theory of filtration, Filter media-characteristics, hydraulics of flow through porous media, slow sand filtration, rapid sand filtration, precoat filtration, direct filtration of water, their design, back washing of filters – design of backwash ,Operational and maintainence problems.

DISINFECTION : Mechanism of disinfection, Factors affecting the disinfection process. Common disinfectants.Chemistry of chlorination, Chlorine handling and dosing, Ozonation, U.V. Disinfection-design criteria.

UNIT –IV

OTHER TREATMENT METHODS:

Adsorption- Definition ,factors affecting adsorption, isotherms. Removal of taste and odour, colour, iron and manganese, fluorides,arsenic,nitrates and desalination of water.

INDUSTRIAL WATER TREATMENT: Boiler feed water-Softening , Ion – exchange and reverse osmosis, Water stabilization, process water for food processing industries.

UNIT –V

WATER PLANT WASTE MANAGEMENT: Need for sludge management, Characteristics and quantities of water processing sludges, Design of water – treatment sludge thickners.Application of pressure filtration and centrifugation for dewatering of sludges. Alum recovery practices. Ultimate disposal of dewatered sludges.

LAYOUT AND HYDRAULIC DESIGN OF WATER TREATMENT PLANTS

Reference Books :

1. Montgomery, water treatment principles and design, Johnwiley and sons, Newyork..
2. Warren Viessman, Jrand Mark J. Hammer, Water Supply and Pollution Control by Harper & Row Publishers, New York.

3.Hazard S. Peavy, Donald R. Rowe and George Tchobanoglous, (1985). Environmental Engineering, McGraw-Hill Book Company, New York.

4J.RWeber (1972), Physicochemical Processes for Water Quality Control,John Wiley and Sons,USA.

Course Outcomes

After completion of course students are

1. Able to assess water quality parameters and aeration methods of water treatment
2. Able to design primary sedimentation tank and clariflocculator
3. Able to plan and design suitable filtration units and disinfection methods for drinking water treatment
4. Capable of applying appropriate advanced water treatment techniques.
5. Able to manage water treatment plant sludges and carry hydraulic design of Water treatment plant.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3		1	2		3	1	
CO2		3	2			3	2	
CO3		3	2	2		3		
CO4		3	3	1		3	2	
CO5		3	2	1		3	2	1

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

EEPC02 AIR POLLUTION AND CONTROL

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT – I

GLOBAL EFFECTS: Acid Rains, Green house effect and Ozone layer depletion.

POLLUTION SOURCES: Anthropogenic and Natural sources of Air pollutants. Types of Air pollutants. Properties of Air pollutants-Particulates, Carbon monoxide, Oxides of sulphur, Nitrogen Oxides, Hydrocarbons.

AIR POLLUTION SAMPLING AND MEASUREMENT –Devices for sampling, Different sampling methods, Sampling of Particulate Matter and Sampling of stack gas. Analysis of air pollutants Sulphur Dioxide, Nitrogen Oxides, Carbon Monoxide, Oxidants and Ozone, Hydrocarbons, Particulate Matter.

UNIT – II

EFFECTS OF AIR POLLUTANTS:

Effects of Carbon monoxide, Particulate Matter, Sulphur Dioxide, Oxides of Nitrogen, Hydrocarbon and photochemical oxidants on human beings. Effects on vegetation - Necrosis, Epinasty, Abscission and Chlorosis. Effects of Arsenic, Fluorine and Lead on animals. Effects of Air pollutants on metals, building materials, paints, textiles, electrical Materials, paper, leather, rubber and economy.

UNIT – III

METEOROLOGICAL ASPECTS OF AIR POLLUTANT DISPERSION:

Wind direction and speed, Temperature, Atmospheric stability, mixing height, Precipitation, Humidity, Solar radiation, Visibility, Inversions and plume behavior. The Gaussian Dispersion Model, Diffusion coefficients, Box model and Puff model.

UNIT - IV

AIR POLLUTION CONTROL METHODS:

CONTROLL OF PARTICULATE MATTER-General methods of control - Zoning - Town planning. Control of particulate matter –Gravity settling chambers, Cyclones, Inertial seperators, scrubbers, bag- filter, Electrostatic Precipitators.

REMOVAL OF GASEOUS MATTER–Control of Sulphur Dioxide by Reinluft process and Westvaco process; Control of $NO_X$by combustion modification, post-flame treatment;VOCs control by adsorption, combustion, condensation and process modification.

BIOMONITORING AND PHYTOREMEDIATION.

UNIT - V

AIR QUALITY AND EMISSION STANDARDS – Ambient Air Quality Standards (2015)

AUTOMOBILE POLLUTION:

Sources, emissions from diesel and petrol engines, Bharat V standards, catalytic convertors, Management of automobile pollution.

AIR POLLUTION AND LEGISLATION: Air Pollution Control Act, 1981, and Environment (Protection) Act, 1986.

Reference Books :

1. Crawford, M (1976). Air Pollution Control Theory, McGraw-Hill, New York.
2. H.C.Perkins (1974). Air Pollution, Mc-Graw Hill, Tokyo.
3. Wark, Kenneth and Cecil F. Warner (1976). Air Pollution : Its Origin and Control, Dun-Dunnelley, New York.

Course Outcomes (COs)

After completion of course student can able to

1. Describe the global effects of air pollution, air pollutants characteristics and sampling methods of air pollutants.
2. Capable of recognizing the effects caused by different air pollutants on human beings, animals, plants and materials.
3. Apply the meteorological aspects of air pollutants dispersion in the different dispersion modeling.
4. Capable of applying advanced technologies to reduce air pollution.
5. To manage automobile pollution and evaluate their efficiency

PO&PSO CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3		2	2		3	1	
CO2	3		2	2		3	2	
CO3	3	1	2	1			3	1
CO4	2	3	3	1		3	3	
CO5	3	3	2	1		3	2	1

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

EEPE12 ENVIRONMENTAL QUALITY AND POLLUTION MONITORING TECHNIQUES

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

INTRODUCTION- Importance of Quantativemeasurements,Character of Environmental Engineering and science problems,standards methods of analysis, scope of a course in analysis of environmental samples, expression of results. Gravemetric methods for solids analysis in water and wastewater.

UNIT-II

TITRAMETRIC METHODS

Determination of acidity, alkalinity,hardness, chloride and residual chlorine.

UNIT-III

INSTRUMENTAL METHODS

Optical methods of analysis, electrical methods of analysis,chromatographic methods,AAS,UV-VIS.

Material characterization techniques- SEM, TEM, XRD, FTIR, thermal analysis- working principles and applications

Determination of nitrogen and phosphate

UNIT-IV

BIOLOGICAL METHODS AND MICROBIOLOGY

Biochemical oxygen demand

MPN test for microbial pollution

Plate counts

Confirmatory test.

UNIT-V

AIR POLLUTION ANALYSIS

Sampling techniques for air pollution measurements, analysis of particulates like PM_{10}, $PM_{2.5}$, $PM_{1.0}$ and common chemical air pollutants like VOC, Hydrocarbons, oxides of nitrogen and sulphur.

Course Outcomes

After completion of course student can

1. Able to do the gravimetric methods for solids analysis
2. Able to apply the different titrimetric methods for pollution monitoring
3. Able to use the different instrumental methods for pollution monitoring.
4. Able to apply the different biological methods for pollution monitoring
5. Able to use the different air analysis methods of pollution monitoring

Reference Books :

1.Chemistry for environmental engineering and science ,fifth edition, by clair N sawyer,PerrylMccarty and Gene F, Parkin.

PO&PSO CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3		2	1		3	2	1
CO2	3		2	1		3	2	1
CO3	3		2	1		3	2	1
CO4	3		2	1		3	2	1
CO5	3		2	1		3	2	1

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

SEPE22 STRUCTURAL HEALTH MONITORING

L / L / week : 3Hrs Sessional Marks : 40

University Exam : 3 Hrs End Exam Marks : 60

Syllabus Contents:

UNIT-I

STRUCTURAL HEALTH: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance.

UNIT-II

STRUCTURAL HEALTH MONITORING: Concepts, Various Measures, Structural Safety in Alteration.

STRUCTURAL AUDIT: Assessment of Health of Structure, Collapse and Investigation,

Investigation Management, SHM Procedures.

UNIT-III

STATIC FIELD TESTING: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.

UNIT-IV

DYNAMIC FIELD TESTING: Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.

UNIT-V

INTRODUCTION TO REPAIRS AND REHABILITATIONS OF STRUCTURES: Case Studies (Site Visits), piezo– electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.

Reference Books:

1. Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006.
2. Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.
3. Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006.
4. Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc, 2007.

Course Outcomes: At the end of the course, students will be able to

1. Diagnosis the distress in the structure understanding the causes and factors.
2. Assess the health of structure using static field methods.
3. Assess the health of structure using dynamic field tests.
4. Suggest repairs and rehabilitation measures of the structure.

PGPA12 DISASTER MANAGEMENT

Instruction Hours/week : 2(L) **Credits : 2**

Sessional Marks : 100 **Semester-end Examination : -**

UNIT I

Introduction

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; natural and Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT II

Repercussions Of Disasters And Hazards

Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Manmade disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III

Disaster Preparedness And Management Preparedness

Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT IV

Risk Assessment Disaster Risk

Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

UNIT V

Disaster Mitigation Meaning

Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

References:

1. R. Nishith, Singh AK, “Disaster Management in India: Perspectives, issues and strategies “’New Royal book Company.

2. Sahni, PardeepEt.Al. (Eds.),” Disaster Mitigation Experiences And Reflections”, Prentice Hall Of India, New Delhi.

3. Goel S. L. , Disaster Administration And Management Text And Case Studies” ,Deep &Deep Publication Pvt. Ltd., New Delhi.

Course outcomes :

At the end of the course, students will be able to:

1. demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

2. critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

3. develop the standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

4. critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

PO&PSO CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1			3	2			3	2
CO2			3	2			3	2
CO3			3	2			3	2
CO4			3	2			3	2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

PGPC 41 - RESEARCH METHODOLOGY AND IPR

L / week	**: 3Hrs**	**Sessional Marks**	**40**
University Exam	**: 3 Hrs**	**End Exam Marks :**	**60**

UNIT 1

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT 2

Effective literature studies approaches, analysis Plagiarism, Research ethics.

UNIT 3

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT 4

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT 5

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT 6

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

Course Outcomes

At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & Nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

PO&PSO CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1			3	2		1	3	2
CO2	3		3	2		1	3	2
CO3			3	2		1	3	2
CO4			3	2		1	3	2
CO5			3	2		1	3	2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

EECP 01 ENVIRONMENTAL ENGINEERING LAB - I

L / week : 4Hrs Sessional Marks : 40

University Exam : 3 Hrs End Exam Marks : 60

Water and Air Analysis

1. (a) Determination of Colour

(b) Determination of Turbidity

(c) Determination of pH

(d) Determination of Temperature and Odour

2. (a) Determination of Total Solids, Dissolved Solids, Suspended Solids.

(b) Determination of Total Volatile and Fixed Solids.

(c) Determination of Electrical Conductivity

3. (a) Determination of Total Acidity

(b) Determination of Total Alkalinity

(c) Determination of Dissolved oxygen

4. (a) Determination of Total Hardness

(b) Determination of Chlorides

(c) Determination of Sulphates

5. Determination of Residual chlorine content

6. Determination of MPN Index:

Presumptive Test

Confirmation Test

Completed Test

Grams Staining Technique

7. Demonstration of Ambient air quality measurement using High Volume Sampler.

Analysis – SPM, NO_x, RSPM, SO_x.

Course Outcomes (COs)

After completion of the course the student will :

1. Use standard methods for assessment for water quality
2. Use statistical principles to analyze and interpret laboratory results
3. Communicate effectively either through written or oral

PO&PSO CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3		2	2		3	2	3
CO2	3		2	2		3	2	3
CO3	3		2	2		3	2	3

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

EECP 02 ENVIRONMENTAL ENGINEERING Lab – II (Practical)

L / week : 4Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

Wastewater and Solid waste Analysis

1. Determination of Total solids,Total suspended solids and Total Dissolved solids
2. Determination of settleable solids
3. Determination of BOD - Evaluation of Kinematic constants.
4. Determination of COD – Open Reflux Method, Block digester method, Colorimetric method and Titrimetric analysis.
5. Determination of Nitrates, TotalKjeldal Nitrogen, Ammonia and Nitrites.
6. Determination of Phosphates
5. Determination of Sulphates.
6. Demonstration of Rotating Biological Contactor
7. Analysis of Municipal Solid Waste – Component, Physical and Chemical Analysis.

Course Outcomes (COs)

After completion of the course the student will :

1. Able to use standard methods to assess wastewater and municipal solid waste characteristics.
2. Use effluent standards to analyze and interpret laboratory results
3. Communicate effectively either through written or oral

PO&PSO CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3		2	2		3	2	3
CO2	3		2	2		3	2	3
CO3	3		2	2		3	2	3

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

II SEMESTER (2022-2023)

S.V.UNIVERSITY COLLEGE OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

TIME-TABLE

Class :M.Tech. (Environmental Engineering) Semester : II Academic Year : 2022-2023

Class Room : YG - 218 With effect from: 03.04.2023

Time / Day	8:30 -9:30 am	9:30 -10:30 am	10:30 -11:30 am	11:30-12:30 pm	LUNCH BREAK	2: 00 – 3:00 pm	3:00-4:00 pm	4:00-5:00 pm
Monday			MSWM (MSM)			EMLab	AWWT (NML)	
Tuesday			MSWM (MSM)			Environmental Modeling Lab (MSM+NML)		
Wednesday			EIA (MSM)			UOPLab	AWWT (NML)	
Thursday			IWWT (NML)			Unit Operations and Process Lab		
Friday			EIA (MSM)				IWWT (NML)	
Saturday			Col (RVS)			Mini-Project		

Course Code	Course Title	Faculty Members
EEPC03	Advanced Wastewater Treatment	Dr.N.Munilakshmi
EEPC04	Municipal Solid Waste Management	Prof.M.Srimurali
EEPE 3...	Professional Elective III :Industrial Wastewater Treatment	Dr.N.Munilakshmi
EEPE 3...	Professional Elective IV :Environmental Impact Assessment	Prof.M.Srimurali
EECP 03	Environmental Modeling Lab	Prof. M.Srimurali + Dr.N.Munilakshmi
EECP 04	Unit Operations and Processes Laboratory	Dr.N.Munilakshmi + Prof.M.Srimurali
EEPA 02	Audit Course -II :Col: Constitution of India	Prof. R.V.S.Satyanarayana
EEMP 01	Mini-Project	Respective Guides

31/3/2023

HEAD OF THE DEPARTMENT

Head
Department of Civil Engineering
S.V.U. College of Engineering
TIRUPATI-517 502 (A.P.)

EEPC03 ADVANCED WASTEWATER TREATMENT

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT – I

GENERAL:

CONSTITUENTS IN DOMESTIC WASTEWATER -BOD, COD, TOC, N AND P – biodegradability, nonbiodegradable organics and other inorganic. **TREATMENT PROCESS AND EFFLUENT DISPOSAL STANDARDS**. **PRIMARY TREATMENT**- Design of Screens, Grit chamber, Sedimentation tanks. **SUSPENDED GROWTH PROCESS:** Activated Sludge Process-ASP and its modifications, process design considerations, evaluation of Biokinetic parameter, Aeration, diffused aeration system.

UNIT – II

ATTACHED GROWTH PROCESS: Substrate removal in attached growth process-design of Trickling filter, rotating biological contactors.

PHOSPHOROUS REMOVAL: Biological phosphorus removal, chemical processes-chemical coagulation,precipitation and oxidation.Tracing phosphorous through treatment processes.

NITROGEN REMOVAL: Biological nitrification and denitrification, ammonia stripping, break point chlorination, and ion–exchange for ammonium (NH^{+}_{4}); Combined removal of nitrogen and phosphorus.Tracing nitrogen through treatment processes.

UNIT – III

ADVANCED PROCESSES:

Granular media filtration, micro screening, MSP like Reverse Osmosis, Electrodialysis, Ultra Filtration, Disinfection of waste water.

REMOVAL OF TOXIC COMPOUNDS AND REFRACTORY ORGANICS : Toxic and refractory organics – Detergents, PCB, phenol, Hydrogenated hydrocarbons, Pesticides and Aromatics. Removal by adsorption, chemical coagulation, Advanced Oxidation Process(AOP).

UNIT – IV

WASTE WATER RECYCLE, REUSE AND RECLAMATION

Ponds,Ditches,Lagoons,UASB,MBR,Constructed wetlands.Waste water Reuse Applications, Waste water Reclamation Technologies-Constituent Removal Technologies-Conventional waste water Treatment process flow diagrams for water Reclamation-Advanced waste water treatment process flow diagrams.

EMERGING CONTAMINANTS IN WASTE WATER- Organic compounds and microorganism, Priority pollutants.

UNIT – V

WASTEWATER TREATMENT PLANT RESIDUE MANAGEMENT

Solids sources, characteristics and quantities-solid processing flow diagram-preliminary operations-Thickening-Digestion-condition-dewatering-Heat drying and composting-Thermal reduction-Reuse.

ENVIROMENTAL AND HYDRAULIC DESIGN OF WASTE WATER TREATMENT PLANTS

Stages of Design- data collection-site layout-Environmental and Hydraulic design.

Reference Books :

1. Metcalf and Eddy, Wastewater Engineering, Tata McGraw Hill Pub. Co.
2. M.J. Hammer, Water and Wastewater Technology, John Wiley and Sons.
3. Sincero Sr., A.P., and G.A.Sincero (1999), Environmental Engineering. A Design Approach Prentice-Hall of India Pvt. Ltd., New Delhi.

Course Outcomes (COs)

After completion of course student can able to

1. Identify and assess the characteristics of wastewater and hence impacts
2. Plan and design components of wastewater treatment plants
3. Understand the advanced process of wastewater treatment
4. Understand principles of wastewater reclamation and reuse
5. To manage sludge and do hydraulic design of wastewater treatment plant.

PO&PSO CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3	1	2			3	2	1
CO2	1	3		3		3	2	1
CO3		3	2	1		3	2	1
CO4		2	3	1		3	2	1
CO5		2	1	1		3	2	1

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

EEPC 04 MUNICIPAL SOLID WASTE MANAGEMENT

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT – I

GENERATION AND CHARACTERISTICS OF SOLID WASTE:

Goals and objectives of solid waste management; Impacts of solid waste generation in a technological society, quantities of solid wastes, elements of solid waste management system, conservation of resources.

Solid waste generation sources; classification of solid waste; data on Indian City wastes; factors influencing generation of solid wastes; components characterization and analysis of solid wastes.

UNIT – II

ONSITE HANDLING, STORAGE AND PROCESSING OF SOLID WASTE:

Public health and aesthetics, onsite handling, methods used at residential and commercial sources; onsite storage dust bins; community containers, container locations; onsite processing methods.

COLLECTION, TRANSFER AND TRANSPORT OF SOLIDWASTE

Collection services, Point collection; frequency of collection, equipment and labour requirements; collection routes, transport means and methods and location of transfer stations.

Design of transfer stations.

UNIT – III

PROCESSING OF SOLID WASTE

Purpose of processing; processing techniques-Mechanical and chemical volume reduction, size reduction, component separation, drying and dewatering.

PROCESSING AND RECOVERY: Thermalrecovery of products – Incineration,pyrolysis and recovery of by-products,Air requirements for combustion-Incineration types-Refuse derived fuels (RDF), biological process and recovery ofconversion products-Composting – static pile, windrow,Vermi composting.

UNIT – IV

DISPOSAL OF SOLID WASTES: Open dumping – problems associated with open dumping sanitary landfills - site selection –design of landfills - Gas and leachate collection and control, ocean disposal of solid wastes. Application of GIS in landfill.

MUNICIPAL SOLID WASTE MANAGEMENT HANDLING RULES (2010).

UNIT – V

HAZARDOUS WASTE MANAGEMENT: Identification and classification of Hazardous wastes, storage, collection and treatment of Hazardous wastes, hazardous waste management rules, Management of Hospital wastes, introduction to e-waste management.

Reference Books:

1. WHO publication SWM for developing countries by frank flintoff**.**

2. Bhide, A.D, and Sundaresan, B.B. (1983) Solid Waste Management in Developing Countries, INSDOC, New Delhi.

3. Tchobanglous, G., Theisen, H. and Ehasin, R. (1996). Solid Waste Engineering Principles and Management Issues - McGraw Hill, Tokyo.

Course Outcomes (COs)

After completion of course students are

1.Able to assess the physical and chemical characteristics of municipal solid waste
2. capable of understanding the elements of solid waste management system.
3. Able to apply different processing methods in the management of municipal solid waste
4. Able to plan and design sanitary landfills for municipal solid waste disposal.
5. Able to apply hazardous waste management rules in handling hazardous waste.

PO&PSO CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3		2			3	2	1
CO2		3	2	1		3	2	1
CO3		3	2	1		3	2	1
CO4		3	2	3		3	2	1
CO5	3	3	2	1		3	2	1

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

EEPE 31 INDUSTRIAL WASTEWATER TREATMENT

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT – I

INDUSTRIAL WASTE REGULATIONS

Industrial activity in India, Guidelines for siting of industries and industrial estates.Characteristics of industrial Wastewater. Differences between industrial wastes and domestic sewage.

IMPACT OF INDUSTRIAL WASTES ON ENVIRONMENT : Impact of acids and alkalies, suspended matter, organic matter (BOD), refractory organics, coloured matter, inorganic solids, heavy metals, foaming agents (detergents), nutrients, oil and greases, biological (pathogenic) wastes, thermal waters and nuclear wastes on the environment.

DISPOSAL STANDARDS OF DISTILLERY, TANNERY, PULP AND PAPER INDUSTRIES

UNIT – II

TREATMENT METHODOLOGY

Neutralization, Equalization, Proportioning, Sedimentation, Flotation , Screening, coagulation, Evaporation, Ion Exchange, Reverse Osmosis, Lagooning, High –rate aerobic treatment, Trickling filtration ,Rotating biological contactors,Anaerobic digestion system.

UNIT-III

OUTLINES OF MANUFACTURING PROCESSES, SOURCES, VOLUMES, CHARCTERISTICS, AND TREATMENT PROCESSES OF MAJOR INDUSTRIES:Sugarcane, distillery, tannery, pulp and paper mills, textile millindustry,fruit processing industry, steel plant industry

UNIT – IV

INDUSTRIAL WASTE MINIMIZATION PRACTICES: Volume reduction, strength reduction, process changes, equipment modifications, chemical substitution, segregation of wastes, equalization of wastes, by product recovery, proportioning wastes.

MANAGEMENT OF INDUSTRIAL SLUDGES: Sources of production of industrial sludges,anaerobic and aerobic digestion, vacuum filtration, elutriation, drying beds, Sludge Lagooning, wet combustion process, drying and incineration, centrifuging, sanitary landfill.

UNIT – V

CLEAN MANUFACTURE PROCESS-Basic concepts of clean technologies, Zero pollution industrial complexes, Introduction to ISO 14000,Life cycle Analysis, pollution pays policy, common effluent treatment plants.

Reference Books :

1. Nemerow, N.L. (1977). Liquid waste of Industry, Theories, Practices and Treatment, Addision-Wesly Publishing Company, London.

2. Mahajan, S.P. (1990). Pollution Control Processing Industries. Tata Mc–Graw – Hill Publishing Company Limited, New Delhi.

3. Rao, M.N.andA.K.Datta. (1979). Wastewater Treatment. Rational Methods of Design and Industrial Practices. Oxford and IBH Publishing Co., New Delhi.

Course Outcomes (COs)

1. Able to describe the concepts of industrial waste regulations.
2. Capable of applying the different preliminary, physical, chemical and biological treatment methods to the industrial waste water
3. Able to describe the characteristics of different types of industrial waste water,its manufacturing process and design units of treatment plant.
4. Capable of reducing the industrial waste and manage industrial sludge
5. Able to apply concepts of clean manufacturing process.

PO&PSO CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3		2	1		3	2	1
CO2		3	2	1		3	2	1
CO3	3	3	2	1		3	2	1
CO4		3	2	2		3	2	1
CO5	3	3	2	1		3	2	1

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

EEPE 41 ENVIRONMENTAL IMPACT ASSESSMENT

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

INTRODUCTION:

Impact of Development on Environment and Environmental Impact Assessment (EIA) and Environmental Impact Statement (EIS) – Objectives – Historical development – EIA Types – EIA in Project cycle- capability and limitations- Legal provisions on EIA.

UNIT-II

METHODOLOGIES:

Elements of EIA – Process screening, Methods of EIA- Strengths, weaknesses and applicability – appropriate methodology.

UNIT-III

PREDICTION AND ASSESSMENT

Socio Economic Impact – Prediction and Assessment of Impact on land, water, air and noise energy impact; Impact on flora and fauna; Mathematical models for prediction; Public participation – Reports – Exchange of Information – Post Audit – rapid EIA.

UNIT-IV

ENVIRONMENTAL MANAGEMENT PLAN:

Plan for mitigation of adverse impact on environment - options for mitigation of impact on water, air and land, flora and fauna; Addressing the issues related to the Project Affected People – Environment management Plan

UNIT-V

LIFE CYCLE ANALYSIS

Elements of Life Cycle Assessment **(**LCA) – Life Cycle Costing – Eco Labelling – Design for the Environment – International Environmental Standards – ISO 14001.

ENVIRONMENTAL AUDIT:

Environmental Audit and Environmental legislation objectives of Environmental Audit,Types of environmental Audit, Audit protocol, stages of Environmental audit, onsite activities,evaluation of Audit data and preparation of Audit report.

TEXT BOOKS

1. Anjaneyulu, Y. Environmental Impact Assessmentmethodologies B.S. Publications,

Hyderabad 2002.

2. Canter, R.L. Environmental Impact Assessment, McGraw Hill Inc.,

NewDelhi,1996.

3. S.K. Shukla and P.R. Srinivastava, Concepts in Environmental Impact

Analysis, Common Wealth Publishers, New Delhi, 1992.

4.Environmental science and Engineering by j. Glynn and Gary W. Hein Ke-

Prentice Hall Publishers.

REFERENCE BOOKS

1. John G.Rau and David C Hooten (Ed)**.,**Environmental Impact Analysis Hand book, McGraw Hill Book Company, 1990.
2. Environmental Assessment Source book, Vol. II and III. The World Bank, Washington, D.C., 1991.
3. Judith Petts, Handbook of Environmental Impact Assessment Vol.I and II. Blackwell Sciencce, New York, 1999.
4. Environmental science and Engineering, by Suresh K.Dhaneja-S.K., Katania and sons Publication., New Delhi.
5. Environmental pollution and control, by Dr. H. S. Bhatia - Galgotia Publication (P) Ltd, Delhi.
6. P. Modak, C. Visvanathan and M. Parasnis, Cleaner Production Audit, Environmental System Reviews, Asian Institute of Technology, Bangkok, 1995.

Course Outcomes

After completion of course student can able to

1. Understand various aspects of EIA
2. Identify suitable methodologies for EIA study
3. Predict and assess the impact on environment
4. Prepare EMP
5. Understand LCA methodology and Environmental audit.

PO&PSO CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1			2	1		3	2	1
CO2	3		1	1		3	2	1
CO3	3		2	1		3	2	1
CO4			3	2		3	2	1
CO5	3	3	2	1		3	2	1

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

EECP 03 ENVIRONMENTAL MODELLING LABORATORY

L / week : 4Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

Design of water supply pipe sections and networks using Software packages like EPANET – Design of Wastewater collection systems, integrated design of water and wastewater treatment plants by using appropriate free domain software packages. Modeling of Air pollutant dispersion using softwares.

Course Outcomes (COs)

1.Able to apply the application of computing techniques in the environmental engineering field.
2. capable of designing the water supply pipe sections and treatment plants using software packages
3. Able to do Modeling of air pollutant dispersion using software packages.

PO&PSO CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3		2			3	2	1
CO2		3	1	1		3	2	1
CO3	3	3	2	1		3	2	1

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

EECP 04 UNIT OPERATIONS AND PROCESSES LABORATORY

L / week : 4Hrs	**Sessional Marks : 40**
University Exam : 3 Hrs	**End Exam Marks : 60**

LIST OF EXPERIMENTS

1. Jar test
2. Sedimentation column analysis
3. Studies on Filtration
4. Adsorption Studies
5. Adsorption studies/Kinetics
6. Activated sludge process
7. Trickling filter
8. Anaerobic Reactor systems (Demonstration)
9. Disinfection for Drinking water

REFERENCES:

1. Metcalf and Eddy. Inc. „Wastewater Engineering, Treatment, Disposal and Reuse, Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
2. Lee, C.C. and Shun dar Lin. Handbook of Environmental Engineering Calculations, McGraw Hill, New York, 1999.
3. Casey T.J., Unit Treatment Processes in Water and Wastewater Engineering, John Wileys Sons, London, 1993.
4. David W.Hendricks, „Water Treatment Unit Processes: Physical and Chemical", CRC Press, Boca Raton, 2006.

Course Outcome:

1. Able to conduct Treatability studies of water and wastewater treatment by various Unit Operations and Processes using laboratory scale models
2. Able to analyze water quality and wastewater characteristics
3. Able to communicate effectively

PO&PSO CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3	2	3	1		3	2	1
CO2	3	2	3	1		3	2	1
CO3		2	3	1		3	2	1

4. ***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

PGPA 21 CONSTITUTION OF INDIA

Instruction Hours/week : 2(L) **Credits : 2**

Sessional Marks : 100 **Semester-end Examination : -**

Course Objectives:

Students will be able to:

1. understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I

History and philosophy of the Indian Constitution

History -Drafting Committee, (Composition & Working) - Preamble - Salient Features

UNIT II

Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT III

Organs of Governance: Parliament – Composition - Qualifications and Disqualifications - Powers and Functions, Executive President – Governor - Council of Ministers - Judiciary, Appointment and Transfer of Judges, Qualifications - Powers and Functions

UNIT IV

Local Administration:

District's Administration Head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT V

Election Commission: Election Commission: Role and Functioning - Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning.

Institute and Bodies for the welfare of SC/ST/OBC and women.

References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

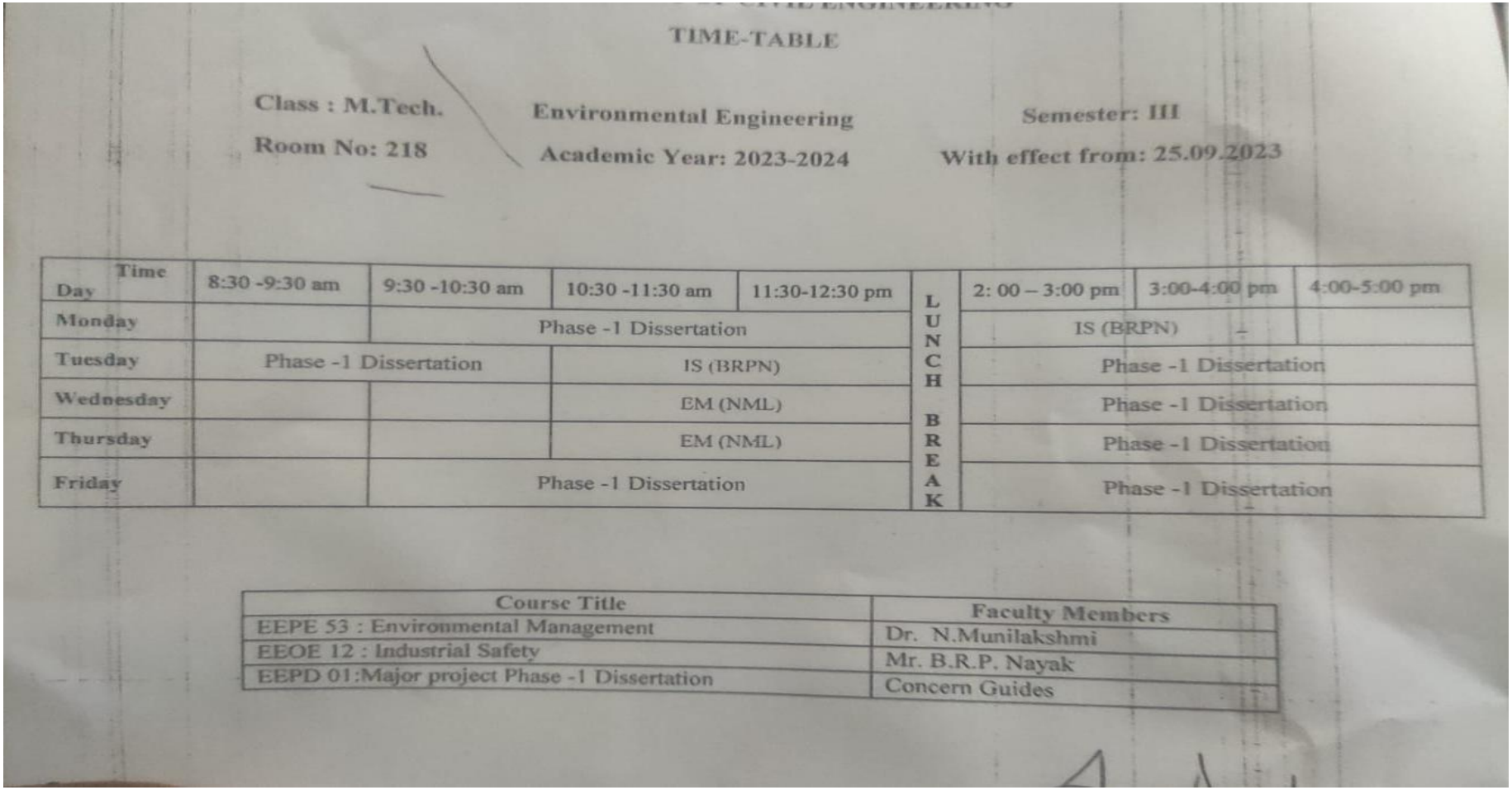
At the end of the course, students will be able to discuss

1. the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. the passage of the Hindu Code Bill of 1956.

PO&PSO CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1				1			1	1
CO2				1			1	1
CO3				1			1	1
CO4				1			1	1

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

III Semester (2023-2024)



TIME-TABLE

Class : M.Tech. Environmental Engineering Semester: III

Room No: 218 Academic Year: 2023-2024 With effect from: 25.09.2023

Time / Day	8:30 -9:30 am	9:30 -10:30 am	10:30 -11:30 am	11:30-12:30 pm	LUNCH BREAK	2: 00 – 3:00 pm	3:00-4:00 pm	4:00-5:00 pm
Monday		Phase -1 Dissertation				IS (BRPN)		
Tuesday	Phase -1 Dissertation		IS (BRPN)			Phase -1 Dissertation		
Wednesday			EM (NML)			Phase -1 Dissertation		
Thursday			EM (NML)			Phase -1 Dissertation		
Friday		Phase -1 Dissertation				Phase -1 Dissertation		

Course Title	Faculty Members
EEPE 53 : Environmental Management	Dr. N.Munilakshmi
EEOE 12 : Industrial Safety	Mr. B.R.P. Nayak
EEPD 01:Major project Phase -1 Dissertation	Concern Guides

EEPE 53 ENVIRONMENTAL MANAGEMENT

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

Environmental Management Standards :

Development, trade and environment linkages – Environmental guidelines – Business and Citizen Charters for Sustainable Production and Consumption - National policies on environment, abatement of pollution and conservation of resources - Environmental quality objectives – Environmental standards - Concentration and Mass standards- Effluent and stream standards – Emission and ambient standards -Minimum national standards - Measuring performance evaluation: Indicators, Benchmarking - Systems approach to environmental management

UNIT-II

Preventive Environmental Management:

Pollution control vis a vis Pollution Prevention - Opportunities and Barriers – Cleaner production and Clean technology, closing the loops, zero discharge technologies - source reduction, raw material substitution, toxic use reduction and elimination, process modification – Cleaner Production Assessment- Material or resource balance – CP option generation and feasibility analysis

UNIT-III

Environmental Management System:

EMAS, ISO 14000 - EMS as per ISO 14001– benefits and barriers of EMS – Concept of continual improvement and pollution prevention - environmental policy – initial environmental review – aspect and impact analysis – legal and other requirements- objectives and targets – environmental management programs – structure and responsibility – training awareness and competence- communication – documentation and document control – operational control – monitoring and measurement – management review.

UNIT-IV

Environmental Audit And Applications:

Environmental management system audits as per ISO 19011- – Roles and qualifications of auditors - Environmental performance indicators and their evaluation – Non conformance – Corrective and preventive actions -compliance audits – waste audits and waste minimization planning – Environmental statement - Due diligence audit -Applications of EMS .

UNIT-V

Waste audits in Industries : Waste Audits and Pollution Prevention opportunities in Textile , Sugar, Pulp & Paper, Electroplating, Mining, petroleum refining, Tanning industry, Dairy, Cement, Chemical industries, etc.

Readings:

1. Hillary, R., Environmental Management Systems and Cleaner Production, Wiley Publishers, 1997

2. Christopher Sheldon and Mark Yoxon, Installing Environmental management Systems – a step by step guide, Earthscan Publications Ltd, London, 1999

3. ISO 14001/14004: Environmental management systems – Requirements and Guidelines – International Organisation for Standardisation, 2004

4. Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations, Second Edition, NSF International, Ann Arbor, Michigan, January 2001

Course Outcomes:

After completion of course student can able to

1. Identify the complex environmental issues and their impact on business and industry
2. Specify strategies and polices used to promote cleaner production in industry
3. Describe criteria and process for implementing environmental management systems
4. Understand different environmental audits
5. Carry waste audits in industries

PO&PSO CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1			2	1			2	1
CO2	3	3	2	1			2	1
CO3		2	3	1			2	1
CO4		2	3	1			2	1
CO5		1	3	2			2	1

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

EEOE 12 INDUSTRIAL SAFETY

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination: 60**

UNIT I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in achine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

References:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Course outcomes:

At the end of the course, students will be able to

1. understand the preventive steps for industrial safety
2. apply the corrosion prevention methods
3. find the causes and tracking of faults in machine tools and equipment
4. understand the periodic and preventive maintenance of mechanical and electrical equipment

PO&PSO CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1			2	1			2	1
CO2		3	2	1			2	1
CO3			3	1			2	1
CO4		2	3	1			2	1

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**



SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

M.Tech Degree Program (CBCS)

Curriculum & Syllabi for Geotechnical Engineering

(w.e.f 2021-22)

MAY, 2018

PROGRAMME OBJECTIVES

1. To make students learn the principles of soil and rock mechanics. Understand different problems Associated with geotechnical engineering. Explain how to select design soil/rock parameters for Design purpose based on the subsurface exploration. Develop Analysis and Design procedure for Various geotechnical structures.
2. Students should gain competency in the design of shallow/deep foundations, earth retaining Structures, embankment and earthen dams, underground structures. Can assess stability of slopes and apply preventive measures for stability.

PROGRAMME OUTCOMES (POs)

1. Students will learn soil and rock behavior. Students will be able to perform various laboratory and in-situ tests on soil/rock to find out design parameters.
2. Students can design shallow/deep foundations, earth retaining structures, embankment and earthen dams, tunnel support systems for given site conditions.
3. Student can compute factor of safety to assess stability of slopes and apply preventive measures for stability.
4. Student can develop numerical models to estimate response of various geotechnical structures under different loadings.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1. To prepare programme graduates with foundation knowledge to perform analysis and design various geotechnical structures for work on site and quality control systems.
2. T o provide programme graduates with entrepreneur skills to take up individual projects or work in teams in the field of geotechnical engineering and in multidisciplinary environments.
3. To inculcate in programme graduates an interest towards research work in the relevant domain or appropriate domains for providing sustainable solutions to the Civil Engineering Problems.

M. Tech (GEOTECHNICAL ENGINEERING) – I Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
GTPC01	Advanced Soil Mechanics	3	-	-	3	3	40	60	100
GTPC02	Advanced Foundation Engineering	3	-	-	3	3	40	60	100
Professional Elective- I Any One from the Following		3	-	-	3	3	40	60	100
GTPE11	Soil Structure Interaction								
GTPE12	Ground Improvement Techniques								
GTPE13	Pavement Analysis and Design								
Professional Elective- II Any One from the Following		3	-	-	3	3	40	60	100
GTPE21	FEM in Geomechanics								
GTPE22	Environmental Geotechnology								
GTPE23	Critical State Soil Mechanics								
GTCP01	Geotechnical Engineering Lab - 1	-	-	4	4	2	40	60	100
GTCP02	Geotechnical Engineering Lab - 2	-	-	4	4	2	40	60	100
GTPA01	Audit Course-I	2	-	-	-	-	-	-	-
PGPC41	Research Methodology and IPR	2	-	-	-	2	40	60	100
	Total	16	-	8	20	18	280	420	700

M. Tech (GEOTECHNICAL ENGINEERING) – II Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
GTPC03	Dynamics of soils and foundations	3	-	-	3	3	40	60	100
GTPC04	Subsurface investigations and instrumentation	3	-	-	3	3	40	60	100
Professional Elective- III Any One from the Following		3	-	-	3	3	40	60	100
GTPE31	Offshore Geotechnical Engineering / Marine Geotechniques								
GTPE32	Computational Geomechanics								
GTPE33	3. Engineering rock mechanics								
Professional Elective- IV Any One from the Following		3	-	-	3	3	40	60	100
GTPE41	Earth Retaining Structures								
GTPE42	Design of underground excavations								
GTPE43	Physical and Constitutive Modelling in Geomechanics								
GTCP03	**Sub soil exploration**	-	-	4	4	2	40	60	100
GTCP04	**Numerical Analysis Lab**	-	-	4	4	2	40	60	100
GTPA02	Audit Course-II	2	-	-	-	-	-	-	-
GTMP01	Mini Project	2	-	-	-	2	100	-	100
	Total	16	-	8	20	18	340	360	700

M. Tech (GEOTECHNICAL ENGINEERING) – III Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Professional Elective- V Any One from the Following		3	-	-	3	3	40	60	100
GTPE51	Stability analysis of slopes								
GTPE52	Foundations on weak rocks								
GTPE53	Geotechnical earthquake engineering								
Open Elective- I Any One from the Following		3	-	-	3	3	40	60	100
GTOE11	Business Analytics								
GTOE12	Industrial Safety								
GTOE13	Operations Research								
GTOE14	Cost Management of Engineering Projects								
GTOE15	Composite Materials								
GTOE16	Energy Generation from Waste								
GTPD01	Major project: Phase-I Dissertation	--	-	20	20	10	100	-	100
	Total	6	-	20	26	16	180	120	300

M. Tech (GEOTECHNICAL ENGINEERING) – IV Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
GTPD02	Major project: Phase-II Dissertation	-	-	32	32	16	40	60	100
Total		-	-	32	32	16	40	60	100

GTPC01 ADVANCED SOIL MECHANICS

L / week	**: 3Hrs**	**Sessional Marks**	**: 40**
University Exam	**: 3 Hrs**	**End Exam Marks**	**: 60**

UNIT I

COMPRESSIBILITY OF SOILS consolidation theory (one, two, and three dimensional consolidation theories), consolidation in layered soil and consolidation for time dependent loading, determination of coefficient of consolidation (Casagrande method and Taylors method)

UNIT II

STRENGTH BEHAVIOR OF SOILS Mohr Circle of Stress; UU, CU, CD tests, drained and undrained behavior of sand and clay, significance of pore pressure parameters; determination of shear strength of soil; Interpretation of triaxial test results.

UNIT III

STRESS PATH Drained and undrained stress path; Stress path with respect to different initial state of the soil; Stress path for different practical situations.

UNIT IV

CRITICAL STATE SOIL MECHANICS Critical state parameters; Critical state for normally consolidated and over consolidated soil; Significance of Roscoe and Hvorslev state boundary surface; drained and undrained plane. Critical void ratio; effect of dilation in sands; different dilation models.

UNIT V

ELASTIC AND PLASTIC DEFORMATIONS elastic wall; introduction to yielding and hardening; yield curve and yield surface, associated and non-associated flow rule.

References

1. Atkinson, J.H. and Bransby, P.L, The Mechanics of Soils: An introduction to Critical Soil Mechanics, McGraw Hill, 1978.
2. Atkinson J.H, An introduction to the Mechanics of soils and Foundation, McGraw- Hill Co., 1993.
3. Das, B.M., Advanced Soil Mechanics, Taylor and Francis, 2nd Edition, 1997.

4. Wood, D.M., Soil Behavior and Critical State Soil Mechanics, Cambridge University Press, 1990.
5. Craig, R.F., Soil Mechanics, Van Nostrand Reinhold Co. Ltd., 1987.
6. Terzaghi, K., and Peck, R.B., Soil Mechanics in Engineering Practice, John Wiley & Sons, 1967.
7. Lambe, T.W. and Whitman, R.V., Soil Mechanics, John Wiley & Sons, 1979.

Course Outcome

1. The students obtain the complete knowledge on Strength and Compressibility of soil mass of soil mass.
2. To learn importance of stress paths on strength Characteristics.
3. The students are able to develop mathematical models for solving different problems in soil mechanics using critical state frame work.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3	2	1	1			3	
CO2			2					
CO3				3			3	

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTPC02 ADVANCED FOUNDATION ENGINEERING

L / week	**: 3Hrs**	**Sessional Marks**	**: 40**
University Exam	**: 3 Hrs**	**End Exam Marks**	**: 60**

UNIT I

SHALLOW FOUNDATIONS Requirements For Satisfactory Performance Of Foundations, Methods Of Estimating Bearing Capacity, Settlements Of Footings And Rafts, Proportioning Of Foundations Using Field Test Data, IS Codes.

UNIT II

PILE FOUNDATIONS Methods Of Estimating Load Transfer Of Piles, Settlements Of Pile Foundations, Pile Group Capacity And Settlement, Negative Skin Friction Of Piles, Laterally Loaded Piles, Pile Load Tests, Analytical Estimation Of Load- Settlement Behavior Of Piles, Proportioning Of Pile Foundations, Lateral And Uplift Capacity Of Piles.

UNIT III

WELL FOUNDATION IS and IRC codal provisions, elastic theory and ultimate resistance methods

UNIT IV

FOUNDATIONS ON PROBLEMATIC SOILS Foundations for collapsible and expansive soils

UNIT V

COFFER DAMS Various Types, Analysis And Design Foundations.

References

1. Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn, 1997.
2. Das B.M., Shallow Foundations: Bearing capacity and settlement, CRC Press, 1999.
3. Tomlinson M.J., Pile design and construction Practice, Chapman and Hall Publication, 1994.
4. Poulos, H. G. and Davis, F. H., “Pile Foundation Analysis and Design”, Wiley and Sons. 1980

Course Outcomes

1. The students will be able to analyse and proportion shallow foundation.
2. To learn load transfer mechanisms and proportioning of deep foundations.
3. To comprehence design aspects of foundations in problematic soils
4. The students will be able to assess the type of foundations to be recommended for construction design of coffer dams.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1		3	2			3	3	
CO2		3	2				2	2
CO3	2	2		2		2		
CO4								2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTPE11 SOIL STRUCTURE INTERACTIONS

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

.

UNIT I: Soil-Foundation Interaction: Introduction to soil-foundation interaction problems, Soil behavior, Foundation behavior, Interface behavior, Scope of soil foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behavior, Time dependent behavior.

UNIT II: Beam on Elastic Foundation- Soil Models: Infinite beam, Two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness.

UNIT III: Plate on Elastic Medium: Thin and thick plates, Analysis of finite plates, Numerical analysis of finite plates, simple solutions.

UNIT IV: Elastic Analysis of Pile: Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap.

UNIT V: Laterally Loaded Pile: Load deflection prediction for laterally loaded piles, Subgrade reaction and elastic analysis.

References

1. Selvadurai, A.P.S, Elastic Analysis of Soil-Foundation Interaction, Elsevier, 1979.
2. Poulos, H.G.,and Davis, E.H.,Pile Foundation Analysis and Design, John Wiley, 1980.
3. Scott, R.F., Foundation Analysis, Prentice Hall, 1981.
4. Structure Soil Interaction-State of Art Report, Institution of Structural Engineers,
5. ACI 336. (1988), Suggested Analysis and Design Procedures for combined footings and Mats, American Concrete Institute.

Course Outcomes

1. The student is exposed to soil foundation interaction behavior
2. The student learns analysis of structures using soils modeling soil as elastic half space and descretes springs.
3. The student will be able to analyse settlements and load distributions in piles and pile groups subjected to vertical and lateral loads.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1		2	2					
CO2							2	2
CO3			3					2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTPE12 GROUND IMPROVEMENT TECHNIQUES

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

INTRODUCTION: situations Where Ground Improvement Becomes Necessary

MECHANICAL MODIFICATION: Dynamic Compaction, Impact Loading, Compaction By Blasting, Vibro-Compaction; Pre-Compression, Stone Columns; Hydraulic Modification: Dewatering Systems, Preloading And Vertical Drains, Electro-Kinetic Dewatering

UNIT II

CHEMICAL MODIFICATION; Modification By Admixtures, Stabilization Using Industrial Wastes, Grouting

UNIT III

THERMAL MODIFICATION: Ground Freezing And Thawing.

UNIT IV

SOIL REINFORCEMENT: Reinforced Earth, Basic Mechanism, Type Of Reinforcements, Selection Of Stabilization/Improvement Of Ground Using Geotextiles, Goegrid, Geomembranes, Geocells, Geonets, And Soil Nails.

UNIT V

APPLICATION OF SOIL REINFORCEMENT: shallow foundations on reinforced earth, design of reinforced earth retaining walls, reinforced earth embankments structures, wall with reinforced backfill, analysis and design of shallow foundations on reinforced earth, road designs with geosynthetics.

References

1. Hausmann, M.R., Engineering Principles of Ground Modification, McGraw-Hill
2. International Editions, 1990.
3. Yonekura, R., Terashi, M. and Shibazaki, M. (Eds.), Grouting and Deep Mixing, A.A. Balkema, 1966.
4. Moseley, M.P., Ground Improvement, Blackie Academic & Professional, 1993.

5. Xanthakos, P.P., Abramson, L.W. and Bruce, D.A., Ground Control and Improvement, John Wiley & Sons, 1994.
6. Koerner, R. M., Designing with Geosynthetics, Prentice Hall Inc. 1998.
7. Shukla, S.K., Yin, Jian-Hua, "Fundamentals of Geosynthetic Engineering", Taylor & Francis.

Course Outcomes

1. Assess the site or ground conditions and judge for adopting ground improvement techniques for a particular structure and site conditions.
2. Select suitable compaction techniques or stabilization methods for improving engineering properties of soils in shallow layers.
3. To modify ground conditions by freezing and thermal methods.
4. Select suitable reinforced earth methods for stabilizing soils in retaining walls and slopes.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1			2			2		
CO2			3				2	2
CO3								
CO4			3			2		2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTPE13 PAVEMENT ANALYSIS AND DESIGN

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Philosophy of design of flexible and rigid pavements,

UNIT II

Analysis of pavements using different analytical methods,

UNIT III

Selection of pavement design input parameters – traffic loading and volume,

UNIT IV

Material characterization, drainage, failure criteria, reliability,

UNIT V

Design of flexible and rigid pavements using different methods, Comparison of different pavement design approaches, design of overlays and drainage system.

References:

1. Yang and H. Huang, Pavement Analysis and Design, Pearson Prentice Hall, 2004.
2. Yoder and Witzech, Pavement Design, McGraw-Hill, 1982.
3. Sharma and Sharma, Principles and Practice of Highway Engg., Asia Publishing House, 1980.
4. Teng, Functional Designing of Pavements, McGraw- Hill, 1980.

Course Outcomes (COs)

The students will be able to

1. Assess the factors affecting the performance of pavements.
2. Identifying failure criteria and design flexible and rigid pavements.
3. Compare and select suitable pavement design approaches, overlays, and design aspects.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1		2	2			3		
CO2							2	2
CO3								

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTPE22 ENVIRONMENTAL GEOTECHNOLOGY

L / week	**: 3Hrs**	**Sessional Marks**	**: 40**
University Exam	**: 3 Hrs**	**End Exam Marks**	**: 60**

UNIT I

SOIL AS A MULTIPHASE SYSTEM; Soil-environment interaction; Properties of water in relation to the porous media; Water cycle with special reference to soil medium.

UNIT II

SOIL MINERALOGY; significance of mineralogy in determining soil behavior; Mineralogical characterization.

UNIT III

MECHANISMS OF SOIL-WATER INTERACTION: Diffuse double layer models; Force of attraction and repulsion; Soil-water-contaminant interaction; Theories of ion exchange; Influence of organic and inorganic chemical interaction.

UNIT IV

CONCEPTS OF WASTE CONTAINMENT; Sources, production and classification of wastes, Environmental laws and regulations, physico-chemical properties of soil, ground water flow and contaminant transport, desirable properties of soil; contaminant transport and retention; contaminated site remediation.

UNIT V

SOIL CHARACTERIZATION TECHNIQUES; volumetric water content; gas permeation in soil; electrical and thermal properties; pore-size distribution; contaminant analysis. contaminated site characterization, estimation of landfill quantities, landfill site location, design of various landfill components such as liners, covers, leachate collection and removal, gas generation and management, ground water monitoring, end uses of landfill sites,

References

1. Mitchell, J.K and Soga, K., Fundamentals of Soil Behavior, John Wiley and Sons Inc., 2005.
2. Fang, H-Y., Introduction to Environmental Geotechnology, CRC Press,1997.
3. Daniel, D.E, Geotechnical Practice for Waste Disposal, Chapman and Hall, 1993.

4. Rowe, R.K., Quigley, R.M. and Booker, J.R., Clay Barrier Systems for Waste Disposal Facilities, E & FN Spon, 1995.
5. Rowe, R.K, Geotechnical and Geoenvironmental Engineering Handbook, Kluwer
6. Academic Publishers, 2001.
7. Reddi, L.N. and Inyang, H.F, Geoenvironmental Engineering - Principles and Applications, Marcel Dekker Inc, 2000.
8. Sharma, H.D. and Lewis, S.P, Waste Containment Systems, Waste Stabilization and Landfills: Design and Evaluation, John Wiley & Sons Inc., 1994.

Course Outcomes

1. Students can understand Soil-environment interaction, Soil mineralogy and
2. Mechanisms of soil-water interaction
3. Students can lean ground water flow and predict contaminant transport phenomenon.
4. Can apply remediation techniques for contaminated site.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1		3	2			3		
CO2								
CO3								
CO4								2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTPE23 CRITICAL STATE SOIL MECHANICS

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

SOIL BEHAVIOR: State of stress and strain in soils, Stress and strain paths and invariants, behavior of soils under different laboratory experiments.

UNIT II

THE CRITICAL STATE LINE and the Roscoe surface: Families of undrained tests, Families of drained tests, the critical state line, drained and undrained surfaces, The Roscoe surface.

UNIT III

BEHAVIOR OF OVER CONSOLIDATED SAMPLES: The Hvorslev surface: Behavior of Over consolidated samples, drained and undrained tests, The Hvorslev surface, complete State Boundary Surface, Volume changes and pore water pressure changes.

UNIT IV

BEHAVIOUR OF SANDS: The critical state line for sands, Normalized plots, the effect of dilation, Consequences of Taylor's model.

UNIT V

BEHAVIOR OF SOILS BEFORE FAILURE: Elastic and plastic deformations, Plasticity theory, Development of elastic-plastic model based on critical state soil mechanics, The Cam-clay model, The modified Cam-clay model.

References:

1. J. H. Atkinson and P. L. Bransby, “The mechanics of soils: An introduction to
2. critical state soil mechanics”, McGraw Hill, 1978.
3. D. M. Wood, “Soil behaviour and critical state soil mechanics”, Cambridge University Press, 1990

4. B. M. Das, "Fundamental of geotechnical engineering", Cengage Learning, 2013

Course Outcomes

The students will be able to :

1. Acquire fundamentals concept of Stresses and Strains and their states in soils.
2. Comprehend the critical state line and the Roscoe surface.
3. Gain knowledge on Cam-Clay model for analyzing the the plastic behaviour of soils before failure.
4. Familiarize with the Development of constitutive laws for geotechnical materials including linear or nonlinear elastic (hyperbolic), linear elastic perfectly plastic, and non-linear elastic-plastic models based on the Critical State Soil Mechanics theory.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2		2			2		
CO2								
CO3		2	2					
CO4			2					2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTCP01 GEOTECHNICAL ENGINEERING LAB - 1

Practicals / week : 4Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

LIST OF PRACTICAL'S:

1. Determination of Moisture Content and Specific gravity of soil

2. Grain Size Distribution Analysis and Hydrometer Analysis

3. Atterberg Limits (Liquid Limit, Plastic limit, Shrinkage limit)

4. Visual Classification Tests

5. Vibration test for relative density of sand iclusive of in-situ density test.

6. Standard and modified proctor compaction test

7. Falling head permeability test and Constant head permeability test

8. Consolidation test.

Course Outcomes (COs):

The students will be able to:

1. Determine all Index Properties for Cohesive and Cohsionless Soils
2. Determine Density Index for Cohesionless Soils.
3. Determine Compaction Characteristics for Cohesive Soils
4. Determine Permeability Characteristics for Cohesive and Cohesionless Soils.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	3	3	2		3	2	1
CO2	2	3	1			2	2	
CO3		3	2	1		2	3	
CO4	2		3	2		2	2	

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTCP02 GEOTECHNICAL ENGINEERING LAB - 2

Practicals / week :	**4Hrs**	**Sessional Marks**	**: 40**
University Exam :	**3 Hrs**	**End Exam Marks**	**: 60**

LIST OF PRACTICALS

1. Unconfined compression test
2. Direct shear test
3. Tri-axial compression test – UU, CU, CD tests
4. Laboratory vane shear test
5. Swelling Characteristics (Swell Pressure, Swell Potentiol and swelling Index) by Free-Swell Odo-Meter method.
6. Swelling Characteristics by Constant Volume Method.

Course Outcomes (COs):

The students will be able to:

1. Determine Unconfined Compressive Stress for Cohesive Soils.
2. Determine shear parameter for Cohesionless Soils.
3. Determine Swelling Characteristics by different methods.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3	3	2	2		2	2	3
CO2	3	3	2	2		2	3	2
CO3	2	3	3	2		2	2	2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTPC41 - RESEARCH METHODOLOGY AND IPR

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT 1

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT 2

Effective literature studies approaches, analysis Plagiarism, Research ethics.

UNIT 3

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT 4

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT 5

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT 6

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2nd Edition , “Research Methodology: A Step by Step Guide for beginners”
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
5. Mayall , “Industrial Design”, McGraw Hill, 1992.
6. Niebel , “Product Design”, McGraw Hill, 1974.
7. Asimov , “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008.

Course Outcomes

At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & Nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1								
CO2								
CO3								
CO4								
CO5								

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTPC03 DYNAMICS OF SOILS AND FOUNDATIONS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

FUNDAMENTALS OF VIBRATIONS: single, two and multiple degree of freedom systems, vibration isolation, vibration absorbers, vibration measuring instruments.

UNIT II

WAVE PROPAGATION: elastic continuum medium, semi-infinite elastic continuum medium, soil behavior under dynamic loading.

UNIT III

DYNAMIC ELASTIC CONSTANTS OF SOIL: determination of dynamic elastic constants, various methods including block resonance tests, cyclic plate load tests, wave propagation tests, oscillatory shear box test.

UNIT IV

MACHINE FOUNDATIONS: Design criteria for machine foundations; Elastic homogeneous half space and lumped parameter solutions, analysis and design of foundations for reciprocating and impact type machines, turbines, effect of machine foundation on adjoining structures.

UNIT V

BEARING CAPACITY OF FOUNDATIONS: Introduction to bearing capacity of dynamically loaded foundations, such as those of water towers, chimneys and high rise buildings.

VIBRATION ISOLATION: Active and passive types of isolation – Screening of vibrations – Isolation in existing machine foundations.

References

1. Das, B.M., “Fundamentals of Soil Dynamics”, Elsevier,1983.
2. Steven Kramer, “Geotechnical Earthquake Engineering”, Pearson,2008.
3. Prakash, S., Soil Dynamics, McGraw Hill, 1981.
4. Kameswara Rao, N.S.V., Vibration analysis and foundation dynamics, Wheeler Publication Ltd., 1998.
5. Richart, F.E. Hall J.R and Woods R.D., Vibrations of Soils and Foundations, Prentice Hall Inc., 1970.
6. Prakash, S. and Puri, V.K., Foundation for machines: Analysis and Design, John Wiley & Sons, 1998.

Course Outcomes

1. Students understands theory of vibration and resonance phenomenon, dynamic amplification
2. Students understand propagation of body waves and surface waves through soil.
3. Student exposed to different methods for estimation of dynamic soil properties required for design purpose.
4. Students apply theory of vibrations to design machine foundation based on dynamic soil properties and bearing capacity.
5. Students can predict dynamic bearing capacity and methods of vibration isolation.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3	3	2	2			2	2
CO2		2				2		
CO3		2		3		2	3	2
CO4		2	3					2
CO5						2		2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTPC04 SUBSURFACE INVESTIGATION AND INSTRUMENTATION

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT - I GENERAL

Purpose of soil exploration – Planning a sub-surface exploration – Stages in sub-surface exploration – Depth of exploration – Lateral extent of exploration.

UNIT - II OPEN EXCAVATION AND BORINGS OF EXPLORATION

Pits and Trenches – Drifts and shafts – Auger Borings – Wash borings – Rotary drilling – Percussion drilling – Core drilling.

UNIT - III SOIL SAMPLES AND SAMPLERS

Types of soil samples – Disturbed samples – Undisturbed samples – Design features affecting the Sample Disturbance – Split Spoon Samplers – Scraper Bucket Samplers – Shellby Tubes and Thin walled Samplers – Piston Samlers – Denison Samplers – Hand-curved Samplers.

UNIT – IV IN-SITU TESTING

Standard Penetration Tests – Cone Penetration Tests – In-situ Vane Shear Test – Plate Load Test – Field Permeability Tests – In-situ Tests Using Pressure meter – Observation of Ground Water Table.

UNIT – V GEOPHYSICAL METHODS

Seismic Methods – Electrical Resistivity Methods – Electrical Profiling Method – Electrical Sounding Method – Common Soil Tests – Sub-soil Investigation Report.

References

1. Subsurface exploration and sampling of soils for Civil Engineering purposes by Hvorslev, M.J., Waterways Experiment Station, Vicksburg, Mississipi, 1949.

2. Foundation Engineering by S.P.Brahma Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 1985.
3. Analysis and Design of Foundations and Retaining Structures by Shamsher Prakash, Gopal Ranjan and Swami Saran, Sarita Prakasham, Meerut, 1979.
4. Soil Mechanics & Foundation Engineering, Vol.2 by V.N.S. Murthy, Sai Kripa Technical Consultants, Bangalore.
5. Geotechnical Engineering by C.Venkatramaiah, Wiley Eastern Ltd., New Delhi. Relevant I.S. Codes.

Course Outcomes

1. Students can plan subsurface investigation based on the requirement of civil engineering project and site condition. Can finalize depth and number of boreholes
2. Students can execute different subsurface exploration tests, collect Disturbed / undisturbed samples for laboratory tests and can suggest design parameters.
3. Student exposed to different methods for estimation of soil properties required for design purpose.
4. Students can develop instrumentation scheme for monitoring of critical sites

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3	3	2	2		2	2	
CO2	3	3	2	2		3		
CO3		2	3	3		2		3
CO4							2	

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTPE31 MARINE GEOTECHNIQUES

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

MARINE SOIL DEPOSITS: Offshore environment, Offshore structures and foundations, Specific problems related to marine soil deposits, Physical and engineering properties of marine soils

UNIT II

BEHAVIOR OF SOILS SUBJECTED TO REPEATED LOADING: Effect of wave loading on offshore foundations, Behavior of sands and clays under cyclic loading, Laboratory experiments including repeated loading, Cyclic behavior of soils based on fundamental theory of mechanics, Approximate engineering methods which can be used for practical cases

UNIT III

SITE INVESTIGATION IN THE CASE OF MARINE SOIL DEPOSITS: Challenges of site investigation in marine environment, Different site investigation techniques, sampling techniques, Geophysical methods, Recent advancements in site investigation and sampling used for marine soil deposits

UNIT IV

FOUNDATIONS IN MARINE SOIL DEPOSITS: Different offshore and near shore foundations, Gravity platforms, Jack-up rigs.

UNIT V

DEEP FOUNDATIONS AND ANCHORS: Pile foundation – Axial capacity – Lateral capacity – Deflections – Construction – Anchored foundations.

References

1. H. G. Poulos. “Marine Geotechnics”, Unwin Hyman Ltd, London, UK, 1988
2. D. V. Reddy and M. Arockiasamy, “Offshore Structures*”, Volume: 1*, R.E. Kreiger Pub and Co., 1991
3. D. Thomson and D. J. Beasley, “Handbook of Marine Geotechnical Engineering”, US Navy, 2012

Course Outcomes

The student is introduced to

1. Physical and Engineering properties of marine soils and problems specific to marine soil deposits.
2. Behavior of sands and clays under cyclic loading
3. Site investigation in marine environment including Geophysical methods.
4. Assess the factors governing the choice of the most suitable type of foundation for a given marine Structure.
5. Select the type of foundation for a given marine Structure.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3	2				3	2	
CO2		3		2				
CO3	2	2					2	
CO4	2	3	2	2				3
CO5		3		3			2	2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTPE32 COMPUTATIONAL GEOMECHANICS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

SOLUTION OF LINEAR EQUATIONS Jacobi's method, Gauss Seidal method, Successive over relaxation method.

UNIT II

FINITE DIFFERENCE METHOD Two point Boundary value problems – Disichlet conditions, Neumann conditions; ordinary and partial differential equations.

UNIT III

CORRELATION AND REGRESSION ANALYSIS Correlation - Scatter diagram, Karl Pearson coefficient of correlation, Limits of correlation coefficient; Regression –Lines of regression, Regression curves, Regression coefficient, Differences between correlation and regression analysis.

UNIT IV

ONE-DIMENSIONAL CONSOLIDATION - Theory of consolidation, Analytical procedures, Finite difference solution procedure for multilayered systems.

UNIT V

FLOW THROUGH POROUS MEDIA - Geotechnical aspects, Numerical methods, Applications and Design analysis.

References

1. S. Chandrakant., Desai and John T. Christian, "Numerical Methods in Geotechnical Engineering", Mc. Graw Hill Book Company, 1977.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, "Numerical Methods for Scientific and Engineering computations", Third edition, New Age International (P) Ltd. Publishers, New Delhi.

3. D.J. Naylor and G.N. Pande, “Finite Elements in Geotechnical Engineering”, Pineridge.

Course Outcomes

Student is able to understand

1. Solution of linear equations
2. Finite difference form of ordinary and partial differential equations
3. Difference between correlation and regression analysis.
4. Apply finite difference technique to solve complex consolidation and seepage problems in Geotechnical Engineering.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2			2		2		2
CO2		2		2				
CO3	2			3				
CO4	2			3		2		3

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTPE33 ENGINEERING ROCK MECHANICS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

ROCK Formation of rocks, Physical properties, Classification of rocks and rock masses, Elastic constants of rock; Insitu stresses in rock. Application of Rock mechanics in Civil Engineering

UNIT II

ROCK TESTING Laboratory and Field tests including field sampling

UNIT III

DISCONTINUITIES IN ROCK MASSES Discontinuity orientation, Effect of discontinuities on strength of rock ;

UNIT IV

STRENGTH BEHAVIOUR Compression, Tension and Shear, Stress-Strain relationships, Rheological behavior

UNIT V

STRENGTH/ FAILURE CRITERION Mohr-Coulomb, Griffith theory, Hoek and Brown, strength and other strength criteria. Stresses in rock near underground openings;

References

1. Hudson J.A. and J.P. Harrison. Engineering Rock Mechanics: an Introduction to the Principles, 1997. Elsevier, Oxford
2. Goodman, R.E. Introduction to Rock Mechanics, John Wiley & Sons.
3. Ramamurthy, T., “Engineering in Rocks”, PHI Learning Pvt. Ltd.
4. Jaeger, J.C. and Cook, N.G.W, Fundamentals of Rock Mechanics, Chapman and Hall, 1976.

5. Wyllie, D.C., Foundations on Rock, E & FN Spon. 2nd Edition, 1992.

Course Outcomes

1. Assess the Physical and Mechanical properties of rocks.
2. Adopt direct & indirect methods of rock exploration.
3. Conduct different laboratory tests on rocks and analyse the results for rock properties
4. Stress Strain behavior under Compressive, tension and Shear
5. Strength criteria functions applied to Rocks.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3	3	3	2		3		
CO2	3	3	2	3				2
CO3	3	3	2	3				2
CO4	2			3		2		
CO5	2	3		3			3	2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTPE41 EARTH RETAINING STRUCTURES

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

EARTH PRESSURE: Rankine and Coulomb theories, active, passive and pressure at rest; concentrated surcharge above the back fill, earth pressure due to uniform surcharge, earth pressure of stratified backfills, saturated and partially saturated backfill.

UNIT II

RETAINING WALLS: Proportioning of retaining walls, stability of retaining walls, mechanically stabilized retaining walls/reinforced earth retaining walls

UNIT III

SHEET PILE WALL: Free earth system, fixed earth system

BULKHEADS: Bulkheads with free and fixed earth supports, equivalent beam method, Anchorage of bulkheads and resistance of anchor walls, spacing between bulkheads and anchor walls, resistance of anchor plates.

UNIT IV

BRACED EXCAVATIONS: Earth pressure against bracings in cuts, Heave of the bottom of cut in soft clays.

UNIT V

TUNNEL AND CONDUIT: Stress distribution around tunnels, Types of conduits, Load on projecting conduits; Arching and Open Cuts: Arching in soils.

References

1. Das, Braja M., "Principles of Foundation Engineering", PWS Publishing. 1998
2. Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn, 1997.

Course Outcomes (COs)

The students will be able to:

1. Develop an understanding of the fundamental concepts that governs the behaviour of Earth and Earth Retaining Structures.
2. Analyze and Design Retaining Walls,
3. Analyze and Design Braced Cuts,
4. Analyze and Design Shafts, Tunnels and Underground Conduits.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	3	3	2		2	2	2
CO2	2	3	2	3			2	2
CO3	3	3	2					2
CO4	2	2	3	2		2	2	3

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTPE42 DESIGN OF UNDERGROUND EXCAVATIONS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Introduction, planning of and exploration for various underground construction projects, stereographic projection method, principle and its application in underground excavation design.

UNIT II

Elastic stress distribution around tunnels, stress distribution for different shapes and under different in-situ stress conditions, Greenspan method, design principles, multiple openings, openings in laminated rocks, elasto-plastic analysis of tunnels, Daemen's theory

UNIT III

Application of rock mass classification systems, ground conditions in tunneling, analysis of underground openings in squeezing and swelling ground, empirical methods, estimation of elastic modulus and modulus of deformation of rocks; uniaxial jacking / plate jacking tests, radial jacking and Goodman jacking tests, long term behavior of tunnels and caverns, New Austrian Tunneling Method (NATM), Norwegian Tunneling Method (NTM), construction dewatering.

UNIT IV

Rock mass-tunnel support interaction analysis, ground response and support reaction curves, Ladanyi'selasto-plastic analysis of tunnels, design of various support systems including concrete and shotcrete linings, steel sets, rock bolting and rock anchoring, combined support systems, estimation of load carrying capacity of rock bolts

UNIT V

In-situ stress, flat jack, hydraulic fracturing and over coring techniques and USBM type drill hole deformation gauge, single and multi-point bore hole extensometers, load cells, pressure cells, etc.

Instrumentation and monitoring of underground excavations, during and after construction, various case studies.

References

1. Hoek, E and and Brown, E. T.," Underground Excavations in Rocks", Institute of Mining Engineering.
2. Obert, L. and Duvall, W.I., "Rock Mechanics and Design of Structures in Rocks", John Wiley.
3. Singh, B. and Goel, R.K.,"Rock Mass Classification- A Practical Engineering Approach", Elsevier.
4. Singh, B. and Goel, R.K., "Tunnelling in Weak Rocks", Elsevier

Course Outcomes

1. Students can plan exploration for various underground projects.
2. Students can understand the use of elastic and plastic analysis in the design of underground support system.
3. Students can classify rock masses and select suitable method for advising tunnels.
4. Design of various tunnel support system.
5. Students will have idea about the field tests generally conducted during and after construction of under structures.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	3				2	2	
CO2	2	2		2		2	2	
CO3	3	3		2		2	2	2
CO4		2	2	2		2	2	
CO5	3	2				2	3	2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTPE43 PHYSICAL AND CONSTITUTIVE MODELLING IN GEOMECHANICS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

ROLE OF CONSTITUTIVE MODELING Importance of laboratory testing with relation to constitutive modeling; Elasticity: linear, quasi linear, anisotropic;

UNIT II

PLASTICITY BASICS: yield criteria, flow rule, plastic potential, hardening/softening; Rate Independent Plasticity: mohr-coulomb, nonlinear failure criteria, Drucker Prager, and cap models;

UNIT III

CRITICAL STATE SOIL MECHANICS: critical state concept, cam clay models, simulation of single element test using cam clay,

UNIT IV

CONSOLIDATION, drained and undrained triaxial test; Stress dilatancy theory;

UNIT V

WORK HARDENING PLASTICITY THEORY: formulation and implementation; Applications of elasto-plastic models; Special Topics: hypoelasticity-plasticity, disturbed state concept.

References

1. Hicher and Shao, “Constitutive Modeling of Soils and Rocks”, John Wiley. 2008
2. C.S. Desai and H. J. Siriwardane, “Constitutive Laws for Engineering Materials with
3. Emphasis on Geologic Materials”, Prentice-Hall, Inc., New Jersey. 1984
4. David M Potts and LidijaZdravkovic, “Finite Element Analysis in Geotechnical Engineering Theory and Application”, Thomas Telford. 1999

5. C.S. Desai, “Mechanics of Materials and Interfaces: The Disturbed State Concept”, CRC Press LLC. 2000
6. A.P.S. Selvadurai, M.J. Boulon, “Mechanics of Geomaterial Interfaces, Elsevier.

Course Outcomes

1. Stress strain models of elasticity of isotropic and anisotropic models.
2. Students can understand theory of plasticity and various yield criteria and flow rule.
3. Students can apply critical state concept to consolidation and triaxial soil behavior.
4. Students can understand the application aspects of elastic plastic models.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2			3				2
CO2	2		2				2	2
CO3	2	2		2		2		2
CO4							2	2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTCP03 SUB SOIL EXPLORATION

L / week	**: 4Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

LIST OF PRACTICALS

1. Field vist
2. Field sampling and transports
3. Determination of Identification tests.
4. Determination of Engineering properties
5. Assessment of Allowable Bearing Pressure of foundations.

Course Outcomes (COs)

1. Evaluate vertical and lateral extent of exploration; identify, select, and plan different stages of subsurface exploration for various civil engineering projects.
2. Discriminate, Classify and analyses different techniques of exploration to be adopted in rocks and soils.
3. Discriminate different types of soil samples, samplers and judge the appropriateness of a sample or sampler for practical cases accounting for the safety and economy.
4. Evaluate different in-situ methods of tests to determine engineering properties of soils and locate Ground water table required for safe and economic design of foundations.
5. Methods of planning, executing, implementing, interpreting, and reporting subsoil investigations based on geophysical methods.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1		3					2	
CO2	3	2	2			2		2
CO3	2	2						2
CO4	2	3		2		2	2	2
CO5	2	2		2				2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTCP04 NUMERICAL ANALYSIS LAB

L / week : 4Hrs **Sessional Marks 40**

University Exam : 3 Hrs **End Exam Marks : 60**

SYLLABUS CONTENTS

1. Develop and Analysis of laboratory tests results using Spread sheets
2. Develop and analysis of Spread sheets for stress distribution, Bearing Capacity and settlements
3. Curve fitting

Course Outcomes (COs)

Student can be

1. Develop and Analysis of laboratory tests results using Spread sheets
2. Develop and analysis of Spread sheets for stress distribution for different loading conditions.
3. Determine Bearing Capacity of given soil sample.
4. Able to determine settlements

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3	2					2	2
CO2				3				
CO3		3		2			2	
CO4	2	2		3			2	2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTPE51 STABILITY ANALYSIS OF SLOPES

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

SLOPES Types and causes of slope failures, mechanics of slope failure, failure modes.

UNIT II

STABILITY ANALYSIS Infinite and finite slopes with or without water pressures; concept of factor of safety, pore pressure coefficients, Mass analysis, Wedge methods, friction circle method ; Method of slices, Bishop's method, Janbu's method, Morgenstern and Price, Spencer's method.

UNIT III

STABILITY ANALYSIS IN THE PRESENCE OF SEEPAGE Two dimensional flow – Laplace equation and it's solution, graphical method, determination of phreatic line, flow nets in homogeneous and zoned earth dams under steady seepage and draw-down conditions, seepage control in earth dams, influence of seepage on slope stability stability analysis of dam body during steady seepage.

UNIT IV

STRENGTHENING MEASURES: stabilization of slopes by drainage methods, surface and subsurface drainage, use of synthetic filters, retaining walls, stabilization and strengthening of slopes, shotcreting, rock bolting and rock anchoring.

UNIT V

Instrumentation and monitoring of slopes, slope movements, warning devices, maintenance of slopes

References:

1. Chowdhary R and ChowdharyI , ”Geotechnical Slope Analysis”, CRC Press.
2. Harr M.E.,” Ground Water and Seepage”, McGraw Hill. 1962

Course Outcomes

1. Identifying types and causes of slope failures.
2. Student will be able to check the stability of earthen dams
3. The safety measures to be undertaken to prevent the instability of slopes, earthen dams and embankments.
4. Understand maintenance and monitoring of slopes.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	2	3			2		
CO2	2	2	2				2	
CO3	2	2	3			2	2	2
CO4	2		3				2	

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTPE52 FOUNDATIONS ON WEAK ROCKS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Engineering properties of weak rocks, different rock mass classification systems, relative merits and demerits. Failure criteria for weak rocks, bi-linear Mohr-Coulomb failure criterion, Hoek and Brown criterion and modified Hoek and Brown failure criterion etc.

UNIT II

Effect of structural planes on rock foundations, possible modes of failure of foundations on rocks/ rock masses, determination of in-situ shear strength of rocks and rock masses

UNIT III

Requirements for satisfactory performance of foundations, bearing capacity of foundations on rocks and rock masses, allowable bearing pressure of rock foundations using a nonlinear failure criterion, monotonic and cyclic plate load tests. Pressure-settlement characteristics, effect of layering, anisotropy, heterogeneity andinelasticity

UNIT IV

Shallow foundations, shallow foundations on sloping ground, raft foundations, stilt foundations, foundations for suspension bridges, transmission line towers, framed buildings etc, treatment of foundations - open joints, solution cavities, weak seams

UNIT V

Piles in weak rocks, bearing capacity and settlement of piles, piles in stratified rock masses, field load tests on piles in weak rocks, behaviour of bored / driven piles in soft / weathered rocks.

References

1. Wyllie Duncan C.," Foundations on Rock: Engineering Practice", E&FN Spon, Taylor and Francis.

2. Hudson J.A. and J.P. Harrison. Engineering Rock Mechanics: an Introduction to the Principles, 1997. Elsevier, Oxford
3. Singh, B. and Goel, R.K.,"Rock Mass Classification- A Practical Engineering Approach", Elsevier.
4. Ramamurthy, T., "Engineering in Rocks", PHI Learning Pvt. Ltd.
5. Hoek, E., "Practical Rock Engineering", Rock science.

Course Outcome

The students will be able to

1. Understand Rock mass classification and its Engineering properties.
2. Determine engineering properties of in-situ rocks and modes of failure associated.
3. Assess allowable Bearing pressure.
4. Design different types of foundations planned over rock mass.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3	2						
CO2	3	2						
CO3	2		3					
CO4	2	3		2		3		2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTPE53 GEOTECHNICAL EARTHQUAKE ENGINEERING

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

EARTHQUAKE SEISMOLOGY Causes of earthquake, Plate tectonics, Earthquake fault sources, Seismic waves, Elastic rebound theory, Quantification of earthquake, Intensity and magnitudes, Earthquake source models.

UNIT II

EARTHQUAKE GROUND MOTION Seismograph, Characteristics of ground motion, Effect of local site conditions on ground motions, Design earthquake, Design spectra, Development of site specification and code-based design.

UNIT III

GROUND RESPONSE ANALYSIS One-dimensional ground response analysis: Linear approaches, Equivalent linear approximation of non-linear approaches.

UNIT IV

LIQUEFACTION AND LATERAL SPREADING Liquefaction related phenomena, Liquefaction susceptibility: Historical, Geological, Compositional and State criteria. Evaluation of liquefaction by cyclic stress and cyclic strain approaches, Lateral deformation and spreading, Criteria for mapping liquefaction hazard zones.

UNIT V

Seismic design of foundations, Seismic slope stability analysis: Internal stability and weakening instability and Seismic design of retaining walls.

References

1. Steven Kramer, “Geotechnical Earthquake Engineering”, Pearson,2008.
2. Seco e Pinto, P., Seismic behaviour of ground and Geotechnical structure, A. A.
3. Naeim, F., The Seismic Design Handbook, Kluwer Academic Publication, 2ndEdition, 2001.
4. Ferrito, J.M, Seismic design criteria for soil liquefaction, Tech. Report of Naval Facilities service centre, Port Hueneme, 1997.

Course Outcomes

1. Students will know the causes and quantification of earthquake.
2. Student will be exposed to the effect of earthquake and ground motion.
3. Student will be able to understand Ground response analysis and Liquefaction effects.
4. Student will be able to understand the seismic design of foundation

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	3	3			2	2	
CO2		2	3			2	2	
CO3			2	2			2	3
CO4			2	2		2		3

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTOE11 BUSINESS ANALYTICS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT II

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology

UNIT III

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT IV

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT V

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

UNIT VI

Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Reference

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

Course Outcomes

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1				2		2	2	
CO2			2	2		2		
CO3				3			3	
CO4				2		2	2	

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTOE12 INDUSTRIAL SAFETY

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV

Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of

electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

References

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Course Outcomes

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1				2		2	2	
CO2			2	2		2		
CO3				3			3	
CO4				2		2	2	

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTOE13 OPERATIONS RESEARCH

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT II

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

UNIT III

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

UNIT IV

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT V

Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008.
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010.

Course Outcomes

1. Students should able to apply the dynamic programming to solve problems of discreet and Continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3			2		2		2
CO2				2			2	
CO3						2	2	
CO4			2	2				2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTOE14 COST MANAGEMENT OF ENGINEERING PROJECTS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

INTRODUCTION AND OVERVIEW OF THE STRATEGIC COST MANAGEMENT PROCESS

Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of CostAccounting A. H. Wheeler publisher.
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Course Outcome

1. Students should able to apply the dynamic programming to solve problems of discreet and Continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2						2	2
CO2								3
CO3			2					2
CO4		2		3		2		3

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTOE15 COMPOSITE MATERIALS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

EARTHQUAKE SEISMOLOGY Causes of earthquake, Plate tectonics, Earthquake fault sources, Seismic waves, Elastic rebound theory, Quantification of earthquake, Intensity and magnitudes, Earthquake source models.

UNIT II

EARTHQUAKE GROUND MOTION Seismograph, Characteristics of ground motion, Effect of local site conditions on ground motions, Design earthquake, Design spectra, Development of site specification and code-based design.

UNIT III

GROUND RESPONSE ANALYSIS One-dimensional ground response analysis: Linear approaches, Equivalent linear approximation of non-linear approaches, Computer code "SHAKE".

UNIT IV

Liquefaction and lateral spreading - Liquefaction related phenomena, Liquefaction susceptibility: Historical, Geological, Compositional and State criteria. Evaluation of liquefaction by cyclic stress and cyclic strain approaches, Lateral deformation and spreading, Criteria for mapping liquefaction hazard zones.

UNIT V

Seismic design of foundations, Seismic slope stability analysis: Internal stability and weakening instability and Seismic design of retaining walls.

Text Books

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References

1. Steven Kramer, "Geotechnical Earthquake Engineering", Pearson,2008.
2. Seco e Pinto, P., Seismic behaviour of ground and Geotechnical structure, A. A.
3. Naeim, F., The Seismic Design Handbook, Kluwer Academic Publication, 2ndEdition, 2001.
4. Ferrito, J.M, Seismic design criteria for soil liquefaction, Tech. Report of Naval Facilities service centre, Port Hueneme, 1997.

Course Outcome

1. Students should able to apply the dynamic programming to solve problems of discreet and Continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis Student should able to model the real world problem and simulate it

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2						2	2
CO2								3
CO3			2					2
CO4		2		3		2		3

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

GTOE16 WASTE TO ENERGY

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I &II, Tata McGraw Hill Publishing Co. Ltd., 1983.

3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course Outcomes

1. Students should able to apply the dynamic programming to solve problems of discreet and Continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis Student should able to model the real world problem and simulate it.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2						2	2
CO2								3
CO3		2		3		2		3

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-18)

Table 1.1.1. Details of courses addressing Local, National, Regional and Global Developmental Needs.

I. Local Needs

Programme name	Programme code	Course name	Course code	Year of Introduction
R18		**M. Tech – I Semester**		
M.Tech GE	1-1422777036	Advanced Soil Mechanics	GTPC01	2018
		Advanced Foundation Engineering	GTPC02	2018
		Professional Elective- I Any One from the Following		
		Soil Structure Interaction	GTPE11	2018
		Ground Improvement Techniques	GTPE12	2018
		Pavement Analysis and Design	GTPE13	2018
		Professional Elective- II Any One from the Following		
		FEM in Geomechanics	GTPE21	2018
		Environmental Geotechnology	GTPE22	2018
		Critical State Soil Mechanics	GTPE23	2018
		Geotechnical Engineering Lab - 1	GTCP01	2018
		Geotechnical Engineering Lab - 2	GTCP02	2018
		Audit Course-I	GTPA01	2018
		Research Methodology and IPR	PGPC41	2018
		M. Tech – II Semester		
M.Tech GE	1-1422777036	Dynamics of soils and foundations	GTPC03	2018
		Subsurface investigations and instrumentation	GTPC04	2018
		Professional Elective- III Any One from the Following		2018
		Offshore Geotechnical Engineering / Marine Geotechniques	GTPE31	2018
		Computational Geomechanics	GTPE32	2018

		Engineering rock mechanics	GTPE33	2018
		Professional Elective- IV Any One from the Following		
		Earth Retaining Structures	GTPE41	2018
		Design of underground excavations	GTPE42	2018
		Physical and Constitutive Modelling in Geo-mechanics	GTPE43	2018
		Sub soil exploration	GTCP03	2018
		Numerical Analysis Lab	GTCP04	2018
		Audit Course-II	GTPA02	2018
		Mini Project	GTMP01	2018
		M. Tech – III Semester		
M.Tech GE	1-1422777036	**Professional Elective- V Any One from the Following**		
		Stability analysis of slopes	GTPE51	2019
		Foundations on weak rocks	GTPE52	2019
		Geotechnical earthquake engineering	GTPE53	2019
		Open Elective- I Any One from the Following		
		Business Analytics	GTOE11	2019
		Industrial Safety	GTOE12	2019
		Operations Research	GTOE13	2019
		Cost Management of Engineering Projects	GTOE14	2019
		Composite Materials	GTOE15	2019
		Energy Generation from Waste	GTOE16	2019
		Major project: Phase-I Dissertation	GTPD01	2019
		M. Tech – IVSemester		
M.Tech GE	1-1422777036	Major project: Phase-II Dissertation	GTPD02	2019

II. National Initiatives/Needs

National green Energy Initiatives:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech GE	1-1422777036	Environmental Geotechnology	GTPE22	2018

National Biotechnology Initiatives:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech GE	1-1422777036	----	---	--

Geographical Integration System (GIS) Initiatives:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech GE	1-1422777036	----	---	--

National Digital Initiative:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech GE	1-1422777036	----	---	--

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-18)

Initiatives on Environment & Sustainability:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech GE	1-1422777036	Environmental Geotechnology	GTPE22	2018
		Energy Generation from Waste	GTOE16	2019

Initiatives on Water Resources:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech GE	1-1422777036			

Initiatives on Agricultural Sustainability:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech GE	1-1422777036	----	---	--

Initiatives on Health Promotions:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech GE	1-1422777036	----	---	--

Initiatives on Nanovission:

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-18)

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech GE	1-1422777036	----	---	--

Initiatives on Translational Mission:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech GE	1-1422777036	----	---	--

Initiatives on Sarva Siksha Abhiyan:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech GE	1-1422777036	----	---	--

Initiatives on Rural Development:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech GE	1-1422777036	Research Methodology and IPR	PGPC41	2018
		Operations Research	GTOE13	2019

III. Regional needs:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech GE	1-1422777036	----	---	--

IV. Global Needs:

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-18)

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech GE	1-1422777036	----	---	--

1.1.3. Employability/ Entrepreneurship/ Skill development – Mapping

S. No.	Name of the Programme	Course Code	Title of the Course	Year of Introduction	Employ ability	Entrepre neurship	Skill development
1	**M.Tech**	GTPC01	Advanced Soil Mechanics	2018	√	√	
2		GTPC02	Advanced Foundation Engineering	2018	√	√	
3		GTPE11	Soil Structure Interaction	2018	√	√	
4		GTPE12	Ground Improvement Techniques	2018	√	√	
5		GTPE13	Pavement Analysis and Design	2018	√	√	
6		GTPE21	FEM in Geomechanics	2018	√	√	
7		GTPE22	Environmental Geotechnology	2018	√	√	
8		GTPE23	Critical State Soil Mechanics	2018	√	√	
9		GTCP01	Geotechnical Engineering Lab - 1	2018	√	√	
10		GTCP02	Geotechnical Engineering Lab - 2	2018	√	√	
11		GTPA01	Audit Course-I	2018	√		

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-18)

12		PGPC41	Research Methodology and IPR	2018	√		
13		GTPC03	Dynamics of soils and foundations	2018	√	√	
14		GTPC04	Subsurface investigations and instrumentation	2018	√	√	
15		GTPE31	Offshore Geotechnical Engineering / Marine Geotechniques	2018	√	√	
16		GTPE32	Computational Geomechanics	2018	√	√	
17		GTPE33	Engineering rock mechanics	2018	√	√	
18		GTPE41	Earth Retaining Structures	2018	√	√	
19		GTPE42	Design of underground excavations	2018	√	√	
20		GTPE43	Physical and Constitutive Modelling in Geomechanics	2018	√	√	
21		GTCP03	Sub soil exploration Lab	2018	√	√	√
22		GTCP04	Numerical Analysis Lab	2018	√	√	√
23		GTPA02	Audit Course-II	2018	√		
24		GTMP01	Mini Project	2018	√	√	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-18)

25		GTPE51	Stability analysis of slopes	2019	√	√	
26		GTPE52	Foundations on weak rocks	2019	√	√	
27		GTPE53	Geotechnical earthquake engineering	2019	√		
28		GTOE11	Business Analytics	2019	√		√
29		GTOE12	Industrial Safety	2019	√		√
30		GTOE13	Operations Research	2019	√		√
31		GTOE14	Cost Management of Engineering Projects	2019	√	√	√
32		GTOE15	Composite Materials	2019	√	√	
33		GTOE16	Energy Generation from Waste	2019	√	√	
34		GTPD01	Major project: Phase-I Dissertation	2019	√	√	√
35		GTPD02	Major project: Phase-II Dissertation	2019	√	√	√

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-18)

1.1.3. Average percentage of Courses having focus on Employability/ Entrepreneurship/ Skill development during the last five years.

S. No	Course Code	Title of the Course	Year of Introduction	Average percentage of Courses having focus on Employability during the last five years
1	GTPC01	Advanced Soil Mechanics	2018	**35/35= 100%**
2	GTPC02	Advanced Foundation Engineering	2018	
3	GTPE11	Soil Structure Interaction	2018	
4	GTPE12	Ground Improvement Techniques	2018	
5	GTPE13	Pavement Analysis and Design	2018	
6	GTPE21	FEM in Geomechanics	2018	
7	GTPE22	Environmental Geotechnology	2018	
8	GTPE23	Critical State Soil Mechanics	2018	
9	GTCP01	Geotechnical Engineering Lab - 1	2018	
10	GTCP02	Geotechnical Engineering Lab - 2	2018	
11	GTPA01	Audit Course-I	2018	
12	PGPC41	Research Methodology and IPR	2018	
13	GTPC03	Dynamics of soils and foundations	2018	
14	GTPC04	Subsurface investigations and instrumentation	2018	
15	GTPE31	Offshore Geotechnical Engineering / Marine Geotechniques	2018	
16	GTPE32	Computational Geomechanics	2018	
17	GTPE33	Engineering rock mechanics	2018	
18	GTPE41	Earth Retaining Structures	2018	
19	GTPE42	Design of underground excavations	2018	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-18)

20	GTPE43	Physical and Constitutive Modelling in Geomechanics	2018	
21	GTCP03	Sub soil exploration lab	2018	
22	GTCP04	Numerical Analysis Lab	2018	
23	GTPA02	Audit Course-II	2018	
24	GTMP01	Mini Project	2018	
25	GTPE51	Stability analysis of slopes	2019	
26	GTPE52	Foundations on weak rocks	2019	
27	GTPE53	Geotechnical earthquake engineering	2019	
28	GTOE11	Business Analytics	2019	
29	GTOE12	Industrial Safety	2019	
30	GTOE13	Operations Research	2019	
31	GTOE14	Cost Management of Engineering Projects	2019	
32	GTOE15	Composite Materials	2019	
33	GTOE16	Energy Generation from Waste	2019	
34	GTPD01	Major project: Phase-I Dissertation	2019	
35	GTPD02	Major project: Phase-II Dissertation	2019	

S. No	Course Code	Title of the Course	Year of Introduction	Average percentage of Courses having focus on Entrepreneurship during the last two years
1	GTPC01	Advanced Soil Mechanics	2018	**29/35= 82.85%**
2	GTPC02	Advanced Foundation Engineering	2018	
3	GTPE11	Soil Structure Interaction	2018	
4	GTPE12	Ground Improvement Techniques	2018	
5	GTPE13	Pavement Analysis and Design	2018	
6	GTPE21	FEM in Geomechanics	2018	
7	GTPE22	Environmental Geotechnology	2018	
8	GTPE23	Critical State Soil Mechanics	2018	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-18)

9	GTCP01	Geotechnical Engineering Lab - 1	2018	
10	GTCP02	Geotechnical Engineering Lab - 2	2018	
11	GTPC03	Dynamics of soils and foundations	2018	
12	GTPC04	Subsurface investigations and instrumentation	2018	
13	GTPE31	Offshore Geotechnical Engineering / Marine Geotechniques	2018	
14	GTPE32	Computational Geomechanics	2018	
15	GTPE33	Engineering rock mechanics	2018	
16	GTPE41	Earth Retaining Structures	2018	
	GTPE42	Design of underground excavations	2018	
17	GTPE43	Physical and Constitutive Modelling in Geomechanics	2018	
18	GTCP03	Sub soil exploration lab	2018	
19	GTCP04	Numerical Analysis Lab	2018	
20	GTMP01	Mini Project	2018	
21	GTPE51	Stability analysis of slopes	2019	
22	GTPE52	Foundations on weak rocks	2019	
23	GTPE53	Geotechnical earthquake engineering	2019	
24	GTOE14	Cost Management of Engineering Projects	2019	
25	GTOE15	Composite Materials	2019	
26	GTOE16	Energy Generation from Waste	2019	
27	GTPD01	Major project: Phase-I Dissertation	2019	
28	GTPD02	Major project: Phase-II Dissertation	2019	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-18)

S. No	Course Code	Title of the Course	Year of Introduction	Average percentage of Courses having focus on Skill development during the last one years
1	GTCP03	Sub soil exploration lab	2018	**8/35= 22.85%**
2	GTCP04	Numerical Analysis Lab	2018	
3	GTOE11	Business Analytics	2019	
4	GTOE12	Industrial Safety	2019	
5	GTOE13	Operations Research	2019	
6	GTOE14	Cost Management of Engineering Projects	2019	
7	GTPD01	Major project: Phase-I Dissertation	2019	
8	GTPD02	Major project: Phase-II Dissertation	2019	

1.2.1. Percentage of new Courses introduced of the total number of courses across all programmes offered during the last two years.

S. No	Course Code	Title of the Course	Year of Introduction	If revision has been carried out in the syllabus during last 2 years, Percentage of content added or replaced
1	GTPE21	FEM in Geomechanics	2018	
2	GTPE22	Environmental Geotechnology	2018	
3	GTPE23	Critical State Soil Mechanics	2018	
4	GTPE51	Stability analysis of slopes	2019	
5	GTPE52	Foundations on weak rocks	2019	
6	GTPE53	Geotechnical earthquake engineering	2019	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-18)

7	GTOE11	Business Analytics	2019	**12/35= 34.28%**
8	GTOE12	Industrial Safety	2019	
9	GTOE13	Operations Research	2019	
10	GTOE14	Cost Management of Engineering Projects	2019	
11	GTOE15	Composite Materials	2019	
12	GTOE16	Energy Generation from Waste	2019	

S. No	Course Code	Title of the Course	Year of Introduction	Activities/Content with direct bearing on Employability/Entrepreneurship/Skill development
	M.Tech-I Semester			
1.	GTPE21	FEM in Geomechanics	2018	
2.	GTPE22	Environmental Geotechnology	2018	To understand Soil-environment interaction, Soil mineralogy and Mechanisms of soil-water interaction and ground water flow and predict contaminant transport phenomenon. Can apply remediation techniques for contaminated site
3.	GTPE23	Critical State Soil Mechanics	2018	Acquire fundamentals concept of Stresses and Strains and their states in soils. Comprehend the critical state line and the Roscoe surface. Gain knowledge on Cam-Clay model for analyzing the the plastic behaviour of soils before failure. Familiarize with the Development of constitutive laws for geotechnical materials including linear

				or nonlinear elastic (hyperbolic), linear elastic perfectly plastic, and non-linear elastic-plastic models based on the Critical State Soil Mechanics theory.
M.Tech-III Semester				
4.	GTPE51	Stability analysis of slopes	2019	Identifying types and causes of slope failures to check the stability of earthen dams and safety measures to be undertaken to prevent the instability of slopes, earthen dams and embankments. Understand maintenance and monitoring of slopes
5.	GTPE52	Foundations on weak rocks	2019	Understand Rock mass classification and its Engineering properties and determine engineering properties of in-situ rocks and modes of failure associated and assess allowable Bearing pressure different types of foundations planned over rock mass
6.	GTPE53	Geotechnical earthquake engineering	2019	To know the causes and quantification of earthquake and effect of earthquake and ground motion to understand ground response analysis and Liquefaction effects and understand the seismic design of foundation

7.	GTOE11	Business Analytics	2019	Demonstrate knowledge of data analytics and think critically in making decisions based on data and deep analytics to use technical skills in predicative and prescriptive modeling to support business decision-making.
8.	GTOE12	Industrial Safety	2019	Decisions making based on data and deep analytics to use technical skills in predicative and prescriptive modeling to support business decision-making the ability to translate data into clear, actionable insights
9.	GTOE13	Operations Research	2019	To apply the dynamic programming to solve problems of discreet and Continuous variables and concept of non-linear programming and able to carry out sensitivity analysis to model the real world problem and simulate it.
10	GTOE14	Cost Management of Engineering Projects	2019	The dynamic programming to solve problems of discreet and Continuous variables to apply the concept of non-linear programming and carry out sensitivity analysis to model the real world problem and simulate it.
11	GTOE15	Composite Materials	2019	To apply the concept of non-linear programming

				and carry out sensitivity analysis and analysis of real world problem
12	GTOE16	Energy Generation from Waste	2019	The dynamic programming to solve problems of discreet and Continuous variables to apply the concept of non-linear programming and carry out sensitivity analysis to model the real world problem and simulate it.

Table. 1.3.1. Courses which address Professional Ethics, Gender, Human Values, Environment and sustainability into the curriculum.

A. Professional Ethics:

Programme name	Programme code	Course name	Course code	Year of Introduction	Description of the course addressing Professional Ethics
M.Tech GE	1-1422777036	**--NIL---**			

B. Gender:

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-18)

Programme name	Programme code	Course name	Course code	Year of Introduction	Description of the course addressing Professional Ethics
M.Tech GE	1-1422777036	**--NIL---**			

C. Human Values:

Programme name	Programme code	Course name	Course code	Year of Introduction	Description of the course addressing Professional Ethics
M.Tech GE	1-1422777036	**--NIL--**			

D. Environment & sustainability:

Programme name	Programme code	Course name	Course code	Year of Introduction	Description of the course addressing Professional Ethics
M.Tech GE	1-1422777036	Environmental Geotechnolog	GTPE22	2018	To understand Soil-environment interaction, Soil mineralogy and Mechanisms of soil-water interaction and ground water flow and predict contaminant transport phenomenon. Can apply

					remediation techniques for contaminated site

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18) Environmental Engineering

Table 1.1.1. Details of courses addressing Local, National, Regional and Global Developmental Needs.

I. Local Needs

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech EE	1-1422777034	Advanced Water Treatment	EEPC01	2018
		Air Pollution and Control	EEPC02	2018
		Professional Elective- I		
		Environmental Chemistry	EEPE11	2018
		Environmental Quality and Pollution Monitoring Techniques	EEPE12	2018
		Rural Water Supply and Onsite Sanitation System	EEPE13	2018
		Ecological Engineering and Stream Ecology	EEPE14	2018
		Professional Elective- II		
		Environmental Microbiology	EEPE 21	2018
		Noise Pollution and Control	EEPE 22	2018
		Ground Water Contamination	EEPE 23	2018
		Transport of Water and Wastewater	EEPE 24	2018
		Environmental Engineering Lab - I	EECP 01	2018
		Environmental Engineering Lab – II	EECP 02	2018
		Audit Course-I		
		English for Research Paper Writing	**PGPA11**	2018
		Disaster Management	**PGPA12**	2018
		Sanskrit for Technical Knowledge	**PGPA 13**	2018
		Value Education	**PGPA14**	2018
		Research Methodology and IPR	PGPC41	2018

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18) Environmental Engineering

M.Tech EE	1-1422777034	Advanced Wastewater Treatment	EEPC03	2018
		Municipal Solid Waste Management	EEPC04	2018
		Professional Elective- III		2018
		Industrial Wastewater Treatment	EEPE 31	2018
		Urban Water Management	EEPE32	2018
		Hazardous Waste Management	EEPE33	2018
		Wastewater Reclamation and Reuse	EEPE34	2018
		Professional Elective- IV		
		Environmental Impact Assessment	EEPE 41	2018
		Sustainable Engineering and Technology	EEPE 42	2018
		Bioremediation	EEPE 43	2018
		Environmental Legislation and Audit	EEPE 44	2018
		Environmental Modeling Lab	EECP 03	2018
		Unit Operations and Processes laboratory	EECP 04	2018
		Audit Course-II		
		Constitution Of India	**PGPA 21**	2018
		Pedagogy Studies	**PGPA 22**	2018
		Stress Management By Yoga	**PGPA 23**	2018
		Personality Development Through Life Enlightenment Skills	**PGPA 24**	2018
		Mini Project	EEMP 01	2018
M.Tech EE	1-1422777034	**Professional Elective- V**		
		Clean Technology	EEPE51	2019
		Mathematical Modeling in Environmental Engineering	EEPE52	2019
		Environmental Management	EEPE53	2019
		Climate Change	EEPE54	2019
		Open Elective- I		
		Business Analytics	EEOE 11	2019

		Industrial Safety	EEOE 12	2019
		Operations Research	EEOE 13	2019
		Cost Management of Engineering Projects	EEOE 14	2019
		Composite Materials	EEOE 15	2019
		Energy Generation from Waste	EEOE 16	2019
		Major project: Phase-I Dissertation	EEPD 01	2019
M.Tech EE	1-1422777034	Major project: Phase-II Dissertation	EEPD 02	2019

II. National Initiatives/Needs

National Green Energy Initiatives:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech EE	1-1422777034	Air Pollution and Control	EEPC02	2018
		Municipal Solid Waste Management	EEPC04	2018
		Advanced Wastewater Treatment	EEPC03	2018
		Industrial Wastewater Treatment	EEPE 31	2018
		Environmental Management	EEPE53	2019
		Energy Generation from Waste	SEOE16	2019

National Biotechnology Initiatives:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech EE	1-1422777034	----	---	--

Geographical Integration System (GIS) Initiatives:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech EE	1-1422777034	----	---	--

National Digital Initiatives:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech EE	1-1422777034	Environmental Modeling Lab	EECP 03	2018

Initiatives on Environment & Sustainability:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech EE	1-1422777034	Energy Generation from Waste	EEOE 16	2019

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18) Environmental Engineering

Initiatives on Water Resources & Sustainability:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech EE	1-1422777034	Advanced Water Treatment	EEPC01	2018

Initiatives on Agricultural & Sustainability:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech EE	1-1422777034	----	---	--

Initiatives on Health & Sustainability:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech EE	1-1422777034	Advanced Water Treatment	EEPC01	2018
		Air Pollution and Control	EEPC02	2018
		Advanced Wastewater Treatment	EEPC03	2018
		Municipal Solid Waste Management	EEPC04	2018

Initiatives on Nanovission & Sustainability:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech EE	1-1422777034	----	---	--

Initiatives on Translational Mission:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech EE	1-1422777034	Sanskrit for Technical Knowledge	PGPA13	2018

Initiatives on Sarva Siksha Abhiyan:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech EE	1-1422777034	Stress Management By Yoga	PGPA23	2018
		Personality Development Through Life Enlightenment Skills	PGPA24	2018

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18) Environmental Engineering

Initiatives on Rural Development:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech EE	1-1422777034	Rural Water Supply and Onsite Sanitation System	EEPE13	2018
		Cost Management of Engineering Projects	SEOE14	2019

III. Regional Needs:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech EE	1-1422777034	Advanced Water Treatment	EEPC01	2018
		Air Pollution and Control	EEPC02	2018
		Professional Elective- I		
		Environmental Chemistry	EEPE11	2018
		Environmental Quality and Pollution Monitoring Techniques	EEPE12	2018
		Rural Water Supply and Onsite Sanitation System	EEPE13	2018
		Ecological Engineering and Stream Ecology	EEPE14	2018
		Professional Elective- II		
		Environmental Microbiology	EEPE 21	2018
		Noise Pollution and Control	EEPE 22	2018
		Ground Water Contamination	EEPE 23	2018
		Transport of Water and Wastewater	EEPE 24	2018
		Environmental Engineering Lab - I	EECP 01	2018
		Environmental Engineering Lab – II	EECP 02	2018
		Audit Course-I		

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18) Environmental Engineering

		English for Research Paper Writing	**PGPA11**	2018
		Disaster Management	**PGPA12**	2018
		Sanskrit for Technical Knowledge	**PGPA 13**	2018
		Value Education	**PGPA14**	2018
		Research Methodology and IPR	PGPC41	2018
M.Tech EE	1-1422777034	Advanced Wastewater Treatment	EEPC03	2018
		Municipal Solid Waste Management	EEPC04	2018
		Professional Elective- III		2018
		Industrial Wastewater Treatment	EEPE 31	2018
		Urban Water Management	EEPE32	2018
		Hazardous Waste Management	EEPE33	2018
		Wastewater Reclamation and Reuse	EEPE34	2018
		Professional Elective- IV		
		Environmental Impact Assessment	EEPE 41	2018
		Sustainable Engineering and Technology	EEPE 42	2018
		Bioremediation	EEPE 43	2018
		Environmental Legislation and Audit	EEPE 44	2018
		Environmental Modeling Lab	EECP 03	2018
		Unit Operations and Processes laboratory	EECP 04	2018
		Audit Course-II		
		Constitution Of India	**PGPA 21**	2018
		Pedagogy Studies	**PGPA 22**	2018
		Stress Management By Yoga	**PGPA 23**	2018
		Personality Development Through Life Enlightenment Skills	**PGPA 24**	2018
		Mini Project	EEMP 01	2018
M.Tech EE	1-1422777034	**Professional Elective- V**		
		Clean Technology	EEPE51	2019

		Mathematical Modeling in Environmental Engineering	EEPE52	2019
		Environmental Management	EEPE53	2019
		Climate Change	EEPE54	2019
		Open Elective- I		
		Business Analytics	EEOE 11	2019
		Industrial Safety	EEOE 12	2019
		Operations Research	EEOE 13	2019
		Cost Management of Engineering Projects	EEOE 14	2019
		Composite Materials	EEOE 15	2019
		Energy Generation from Waste	EEOE 16	2019
		Major project: Phase-I Dissertation	EEPD 01	2019
M.Tech EE	1-1422777034	Major project: Phase-II Dissertation	EEPD 02	2019

III. Global Needs:

Programme name	Programme code	Course name	Course code	Year of Introduction
M.Tech EE	1-1422777034	Disaster Management	PGPA12	2018
		Research Methodology and IPR	PGPC41	2018
		Business Analytics	EEOE 11	2019
		Industrial Safety	EEOE 12	2019
		Operations Research	EEOE 13	2019

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18) Environmental Engineering

1.1.3. Employability/ Entrepreneurship/ Skill development – Mapping

S. No.	Name of the Programme	Course Code	Title of the Course	Year of Introduction	Employ ability	Entrepre neurship	Skill development
1	M.Tech EE	EEPC01	Advanced Water Treatment	2018	√	√	
2		EEPC02	Air Pollution and Control	2018	√	√	
			Professional Elective- I				
3		EEPE11	Environmental Chemistry	2018	√		
4		EEPE12	Environmental Quality and Pollution Monitoring Techniques	2018	√		
5		EEPE13	Rural Water Supply and Onsite Sanitation System	2018	√		
			Professional Elective- II				
6		EEPE 21	Environmental Microbiology	2018	√		

7		EEPE 22	Noise Pollution and Control	2018	√	√	
8		EEPE 23	Ground Water Contamination	2018	√		
9		EEPE 24	Transport of Water and Wastewater	2018	√	√	
10		EECP 01	Environmental Engineering Lab - I	2018	√	√	√
11		EECP 02	Environmental Engineering Lab – II	2018	√	√	√
			Audit Course-I				
12		PGPA11	English for Research Paper Writing	2018			√
13		PGPA12	Disaster Management	2018	√	√	√
14		PGPA13	Sanskrit for Technical Knowledge	2018			√
15		PGPA14	Value Education	2018	√		
16		PGPC41	Research Methodology and IPR	2018	√	√	
17		EEPC03	Advanced Wastewater Treatment	2018	√	√	

18		EEPC04	Municipal Solid Waste Management	2018	√	√	
			Professional Elective- III				
19		EEPE 31	Industrial Wastewater Treatment	2018	√	√	
20		EEPE32	Urban Water Management	2018	√	√	
21		EEPE33	Hazardous Waste Management	2018	√	√	
22		EEPE34	Wastewater Reclamation and Reuse	2018	√	√	
			Professional Elective- IV				
23		EEPE 41	Environmental Impact Assessment	2018	√	√	
24		EEPE 42	Sustainable Engineering and Technology	2018	√	√	
25		EEPE 43	Bioremediation	2018	√		
26		EEPE 44	Environmental Legislation and Audit	2018	√	√	

27		EECP 03	Environmental Modeling Lab	2018	√	√	√
28		EECP 04	Unit Operations and Processes laboratory	2018	√	√	√
			Audit Course-II				
29		PGPA21	Constitution Of India	2018	√	√	
30		PGPA22	Pedagogy Studies	2018			√
31		PGPA23	Stress Management By Yoga	2018			√
32		PGPA24	Personality Development Through Life Enlightenment Skills	2018			√
33		EEMP01	Mini Project	2018	√	√	√
			Professional Elective- V				
34		EEPE51	Clean Technology	2019	√		
35		EEPE52	Mathematical Modeling in Environmental Engineering	2019	√		
36		EEPE53	Environmental Management	2019	√		

37		EEPE54	Climate Change	2019	√	√	
			Open Elective- I				
38		EEOE 11	Business Analytics	2019		√	
39		EEOE 12	Industrial Safety	2019	√		
40		EEOE 13	Operations Research	2019	√		
41		EEOE 14	Cost Management of Engineering Projects	2019	√		
42		EEOE 15	Composite Materials	2019	√		
43		EEOE 16	Energy Generation from Waste	2019	√		
44		EEPD 01	Major project: Phase-I Dissertation	2019	√	√	√
45		EEPD 02	Major project: Phase-II Dissertation	2019	√	√	√

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18) Environmental Engineering

1.1.3. Average percentage of Courses having focus on Employability/ Entrepreneurship/ Skill development during the last five years.

S. No.	Name of the Programme	Course Code	Title of the Course	Year of Introduction	Employ ability	Entrepre neurship	Skill development
1	M.Tech EE	EEPC01	Advanced Water Treatment	2018	√	√	
2		EEPC02	Air Pollution and Control	2018	√	√	
			Professional Elective- I				
3		EEPE11	Environmental Chemistry	2018	√		
4		EEPE12	Environmental Quality and Pollution Monitoring Techniques	2018	√		
5		EEPE13	Rural Water Supply and Onsite Sanitation System	2018	√		
			Professional Elective- II				
6		EEPE 21	Environmental Microbiology	2018	√		

7		EEPE 22	Noise Pollution and Control	2018	√	√	
8		EEPE 23	Ground Water Contamination	2018	√		
9		EEPE 24	Transport of Water and Wastewater	2018	√	√	
10		EECP 01	Environmental Engineering Lab - I	2018	√	√	√
11		EECP 02	Environmental Engineering Lab – II	2018	√	√	√
			Audit Course-I				
12		PGPA11	English for Research Paper Writing	2018			√
13		PGPA12	Disaster Management	2018	√	√	√
14		PGPA13	Sanskrit for Technical Knowledge	2018			√
15		PGPA14	Value Education	2018	√		
16		PGPC41	Research Methodology and IPR	2018	√	√	
17		EEPC03	Advanced Wastewater Treatment	2018	√	√	

18		EEPC04	Municipal Solid Waste Management	2018	√	√	
			Professional Elective- III				
19		EEPE 31	Industrial Wastewater Treatment	2018	√	√	
20		EEPE32	Urban Water Management	2018	√	√	
21		EEPE33	Hazardous Waste Management	2018	√	√	
22		EEPE34	Wastewater Reclamation and Reuse	2018	√	√	
			Professional Elective- IV				
23		EEPE 41	Environmental Impact Assessment	2018	√	√	
24		EEPE 42	Sustainable Engineering and Technology	2018	√	√	
25		EEPE 43	Bioremediation	2018	√		
26		EEPE 44	Environmental Legislation and Audit	2018	√	√	

27		EECP 03	Environmental Modeling Lab	2018	√	√	√
28		EECP 04	Unit Operations and Processes laboratory	2018	√	√	√
			Audit Course-II				
29		PGPA21	Constitution Of India	2018	√	√	
30		PGPA22	Pedagogy Studies	2018			√
31		PGPA23	Stress Management By Yoga	2018			√
32		PGPA24	Personality Development Through Life Enlightenment Skills	2018			√
33		EEMP01	Mini Project	2018	√	√	√
			Professional Elective- V				
34		EEPE51	Clean Technology	2019	√		
35		EEPE52	Mathematical Modeling in Environmental Engineering	2019	√		
36		EEPE53	Environmental Management	2019	√		

37		EEPE54	Climate Change	2019	√	√	
			Open Elective- I				
38		EEOE 11	Business Analytics	2019		√	
39		EEOE 12	Industrial Safety	2019	√		
40		EEOE 13	Operations Research	2019	√		
41		EEOE 14	Cost Management of Engineering Projects	2019	√		
42		EEOE 15	Composite Materials	2019	√		
43		EEOE 16	Energy Generation from Waste	2019	√		
44		EEPD 01	Major project: Phase-I Dissertation	2019	√	√	√
45		EEPD 02	Major project: Phase-II Dissertation	2019	√	√	√

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18) Environmental Engineering

S. No.	Name of the Programme	Course Code	Title of the Course	Year of Introduction	Employability Average percentage of Courses having focus on Employability during the last five years
1	M.Tech EE	EEPC01	Advanced Water Treatment	2018	39/45=87%
2		EEPC02	Air Pollution and Control	2018	
			Professional Elective- I		
3		EEPE11	Environmental Chemistry	2018	
4		EEPE12	Environmental Quality and Pollution Monitoring Techniques	2018	
5		EEPE13	Rural Water Supply and Onsite Sanitation System	2018	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18) Environmental Engineering

			Professional Elective- II		
6		EEPE 21	Environmental Microbiology	2018	
7		EEPE 22	Noise Pollution and Control	2018	
8		EEPE 23	Ground Water Contamination	2018	
9		EEPE 24	Transport of Water and Wastewater	2018	
10		EECP 01	Environmental Engineering Lab - I	2018	
11		EECP 02	Environmental Engineering Lab – II	2018	
			Audit Course-I		
12		PGPA11	English for Research Paper Writing	2018	
13		PGPA12	Disaster Management	2018	
14		PGPA13	Sanskrit for Technical Knowledge	2018	
15		PGPA14	Value Education	2018	
16		PGPC41	Research Methodology and IPR	2018	

17		EEPC03	Advanced Wastewater Treatment	2018	
18		EEPC04	Municipal Solid Waste Management	2018	
			Professional Elective- III		
19		EEPE 31	Industrial Wastewater Treatment	2018	
20		EEPE32	Urban Water Management	2018	
21		EEPE33	Hazardous Waste Management	2018	
22		EEPE34	Wastewater Reclamation and Reuse	2018	
			Professional Elective- IV		
23		EEPE 41	Environmental Impact Assessment	2018	
24		EEPE 42	Sustainable Engineering and Technology	2018	
25		EEPE 43	Bioremediation	2018	
26		EEPE 44	Environmental Legislation and Audit	2018	
27		EECP 03	Environmental Modeling Lab	2018	
28		EECP 04	Unit Operations and Processes laboratory	2018	

			Audit Course-II		
29		PGPA21	Constitution Of India	2018	
30		PGPA22	Pedagogy Studies	2018	
31		PGPA23	Stress Management By Yoga	2018	
32		PGPA24	Personality Development Through Life Enlightenment Skills	2018	
33		EEMP01	Mini Project	2018	
			Professional Elective- V		
34		EEPE51	Clean Technology	2019	
35		EEPE52	Mathematical Modeling in Environmental Engineering	2019	
36		EEPE53	Environmental Management	2019	
37		EEPE54	Climate Change	2019	
			Open Elective- I		
38		EEOE 11	Business Analytics	2019	
39		EEOE 12	Industrial Safety	2019	

40		EEOE 13	Operations Research	2019	
41		EEOE 14	Cost Management of Engineering Projects	2019	
42		EEOE 15	Composite Materials	2019	
43		EEOE 16	Energy Generation from Waste	2019	
44		EEPD 01	Major project: Phase-I Dissertation	2019	
45		EEPD 02	Major project: Phase-II Dissertation	2019	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18) Environmental Engineering

S. No.	Name of the Programme	Course Code	Title of the Course	Year of Introduction	Average percentage of Courses having focus on Entrepreneurship during the last five years
1	M.Tech EE	EEPC01	Advanced Water Treatment	2018	25/45=56%
2		EEPC02	Air Pollution and Control	2018	
			Professional Elective- I		
3		EEPE11	Environmental Chemistry	2018	
4		EEPE12	Environmental Quality and Pollution Monitoring Techniques	2018	
5		EEPE13	Rural Water Supply and Onsite Sanitation System	2018	
			Professional Elective- II		
6		EEPE 21	Environmental Microbiology	2018	
7		EEPE 22	Noise Pollution and Control	2018	

8		EEPE 23	Ground Water Contamination	2018	
9		EEPE 24	Transport of Water and Wastewater	2018	
10		EECP 01	Environmental Engineering Lab - I	2018	
11		EECP 02	Environmental Engineering Lab – II	2018	
			Audit Course-I		
12		PGPA11	English for Research Paper Writing	2018	
13		PGPA12	Disaster Management	2018	
14		PGPA13	Sanskrit for Technical Knowledge	2018	
15		PGPA14	Value Education	2018	
16		PGPC41	Research Methodology and IPR	2018	
17		EEPC03	Advanced Wastewater Treatment	2018	
18		EEPC04	Municipal Solid Waste Management	2018	
			Professional Elective- III		
19		EEPE 31	Industrial Wastewater Treatment	2018	

20		EEPE32	Urban Water Management	2018	
21		EEPE33	Hazardous Waste Management	2018	
22		EEPE34	Wastewater Reclamation and Reuse	2018	
			Professional Elective- IV		
23		EEPE 41	Environmental Impact Assessment	2018	
24		EEPE 42	Sustainable Engineering and Technology	2018	
25		EEPE 43	Bioremediation	2018	
26		EEPE 44	Environmental Legislation and Audit	2018	
27		EECP 03	Environmental Modeling Lab	2018	
28		EECP 04	Unit Operations and Processes laboratory	2018	
			Audit Course-II		
29		PGPA21	Constitution Of India	2018	
30		PGPA22	Pedagogy Studies	2018	
31		PGPA23	Stress Management By Yoga	2018	
32		PGPA24	Personality Development Through Life	2018	

			Enlightenment Skills		
33		EEMP01	Mini Project	2018	
			Professional Elective- V		
34		EEPE51	Clean Technology	2019	
35		EEPE52	Mathematical Modeling in Environmental Engineering	2019	
36		EEPE53	Environmental Management	2019	
37		EEPE54	Climate Change	2019	
			Open Elective- I		
38		EEOE 11	Business Analytics	2019	
39		EEOE 12	Industrial Safety	2019	
40		EEOE 13	Operations Research	2019	
41		EEOE 14	Cost Management of Engineering Projects	2019	
42		EEOE 15	Composite Materials	2019	
43		EEOE 16	Energy Generation from Waste	2019	

44		EEPD 01	Major project: Phase-I Dissertation	2019	
45		EEPD 02	Major project: Phase-II Dissertation	2019	

S. No.	Name of the Programme	Course Code	Title of the Course	Year of Introduction	Average percentage of Courses having focus on Skill development during the last five years
1	M.Tech EE	EEPC01	Advanced Water Treatment	2018	13/45=29%
2		EEPC02	Air Pollution and Control	2018	
			Professional Elective- I		
3		EEPE11	Environmental Chemistry	2018	
4		EEPE12	Environmental Quality and Pollution Monitoring Techniques	2018	
5		EEPE13	Rural Water Supply and Onsite Sanitation System	2018	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18) Environmental Engineering

			Professional Elective- II		
6		EEPE 21	Environmental Microbiology	2018	
7		EEPE 22	Noise Pollution and Control	2018	
8		EEPE 23	Ground Water Contamination	2018	
9		EEPE 24	Transport of Water and Wastewater	2018	
10		EECP 01	Environmental Engineering Lab - I	2018	
11		EECP 02	Environmental Engineering Lab – II	2018	
			Audit Course-I		
12		PGPA11	English for Research Paper Writing	2018	
13		PGPA12	Disaster Management	2018	
14		PGPA13	Sanskrit for Technical Knowledge	2018	
15		PGPA14	Value Education	2018	
16		PGPC41	Research Methodology and IPR	2018	
17		EEPC03	Advanced Wastewater Treatment	2018	

18		EEPC04	Municipal Solid Waste Management	2018	
			Professional Elective- III		
19		EEPE 31	Industrial Wastewater Treatment	2018	
20		EEPE32	Urban Water Management	2018	
21		EEPE33	Hazardous Waste Management	2018	
22		EEPE34	Wastewater Reclamation and Reuse	2018	
			Professional Elective- IV		
23		EEPE 41	Environmental Impact Assessment	2018	
24		EEPE 42	Sustainable Engineering and Technology	2018	
25		EEPE 43	Bioremediation	2018	
26		EEPE 44	Environmental Legislation and Audit	2018	
27		EECP 03	Environmental Modeling Lab	2018	
28		EECP 04	Unit Operations and Processes laboratory	2018	
			Audit Course-II		

29		PGPA21	Constitution Of India	2018	
30		PGPA22	Pedagogy Studies	2018	
31		PGPA23	Stress Management By Yoga	2018	
32		PGPA24	Personality Development Through Life Enlightenment Skills	2018	
33		EEMP01	Mini Project	2018	
			Professional Elective- V		
34		EEPE51	Clean Technology	2019	
35		EEPE52	Mathematical Modeling in Environmental Engineering	2019	
36		EEPE53	Environmental Management	2019	
37		EEPE54	Climate Change	2019	
			Open Elective- I		
38		EEOE 11	Business Analytics	2019	
39		EEOE 12	Industrial Safety	2019	
40		EEOE 13	Operations Research	2019	

41		EEOE 14	Cost Management of Engineering Projects	2019	
42		EEOE 15	Composite Materials	2019	
43		EEOE 16	Energy Generation from Waste	2019	
44		EEPD 01	Major project: Phase-I Dissertation	2019	
45		EEPD 02	Major project: Phase-II Dissertation	2019	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
M.Tech. Civil Engineering (R-18) Environmental Engineering

1.2.1. Percentage of new Courses introduced of the total number of courses across all programmes offered during the last five years.

S. No.	Name of the Programme	Course Code	Title of the Course	Year of Introduction	If revision has been carried out in the syllabus during last 5 years, Percentage of content added or replaced
1	**M.Tech EE**	PGPA11	English for Research Paper Writing	2018	18/45 =40%
2		PGPA12	Disaster Management	2018	
3		PGPA13	Sanskrit for Technical Knowledge	2018	
4		PGPA14	Value Education	2018	
5		PGPC41	Research Methodology and IPR	2018	
6		PGPA21	Constitution Of India	2018	
7		PGPA22	Pedagogy Studies	2018	
8		PGPA23	Stress Management By Yoga	2018	
9		PGPA24	Personality Development Through Life Enlightenment Skills	2018	
10		EEMP01	Mini Project	2018	
11		EEOE 11	Business Analytics	2019	

12		EEOE 12	Industrial Safety	2019	
13		EEOE 13	Operations Research	2019	
14		EEOE 14	Cost Management of Engineering Projects	2019	
15		EEOE 15	Composite Materials	2019	
16		EEOE 16	Energy Generation from Waste	2019	
17		EEPD 01	Major project: Phase-I Dissertation	2019	
18		EEPD 02	Major project: Phase-II Dissertation	2019	

Activities/Content with direct bearing on Employability/Entrepreneurship/Skill development

Programme name	Programme code	Course name	Course code	Year of Introduction	Activities/Content with direct bearing on Employability/Entrepreneurship/Skill development
M.Tech EE	1-1422777034	Advanced Water Treatment	EEPC01	2018	Understand the various treatments suitable for different types of water sources and apply appropriate treatment method

		Air Pollution and Control	EEPC02	2018	Able to analyze the ambient air quality and to apply suitable treatment technologies
		Professional Elective- I			
		Environmental Chemistry	EEPE11	2018	Understand the concepts of molarity and to analyze the chemical reactions involved in the process
		Environmental Quality and Pollution Monitoring Techniques	EEPE12	2018	To analyze the quality of air, water and characteristics of wastewater, solid waste through different weighing, titrimetric and instrumental methods.
		Rural Water Supply and Onsite Sanitation System	EEPE13	2018	Apply protected rural water supply scheme and implement onsite sanitation systems
		Ecological Engineering and Stream Ecology	EEPE14	2018	Understand the different aspects of stream ecology
		Professional Elective- II			
		Environmental Microbiology	EEPE 21	2018	Able to classify the different types of microorganisms and their applications in the wastewater treatment, impacts on human health
		Noise Pollution and Control	EEPE 22	2018	Understand type of measures that can be applied to control noise pollution from different sources.
		Ground Water Contamination	EEPE 23	2018	Different types of ground water contaminants and their control can be explained.
		Transport of Water and Wastewater	EEPE 24	2018	Understand the different ways of transport of water and wastewater

		Environmental Engineering Lab - I	EECP 01	2018	Analyze the quality of water
		Environmental Engineering Lab – II	EECP 02	2018	Analyze the strength of wastewater
		Audit Course-I			
		English for Research Paper Writing	**PGPA11**	2018	understand how to improve writing skills and level of readability
		Disaster Management	**PGPA12**	2018	To understand the key concepts in disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
		Sanskrit for Technical Knowledge	**PGPA 13**	2018	understand the Ancient Sanskrit literature about science & technology
		Value Education	**PGPA14**	2018	acquire the knowledge of self-development
		Research Methodology and IPR	PGPC41	2018	To understand research problem formulation and analyze research related information with following research ethics To understand the nature and development Intellectual property rights (IPR)
M.Tech EE	1-1422777034	Advanced Wastewater Treatment	EEPC03	2018	To understand the characteristics of wastewater and to apply appropriate treatment method for treating

					wastewater.
		Municipal Solid Waste Management	EEPC04	2018	Able to characterize the solid waste and can able to manage solid waste scientifically
		Professional Elective- III			
		Industrial Wastewater Treatment	EEPE 31	2018	Able to characterize different types of industrial wastewater and apply suitable treatment method.
		Urban Water Management	EEPE32	2018	Able to give solution to management of urban water
		Hazardous Waste Management	EEPE33	2018	Characterize the hazardous waste and able to manage scientifically
		Wastewater Reclamation and Reuse	EEPE34	2018	Able to apply different suitable treatment methods to reuse the treated wastewater.
		Professional Elective- IV			
		Environmental Impact Assessment	EEPE 41	2018	Able to asses different impacts for a proposed/ongoing/completed engineering project
		Sustainable Engineering and Technology	EEPE 42	2018	Able to apply sustainable solutions for a given engineering project
		Bioremediation	EEPE 43	2018	Apply treatment methods of bioremediation
		Environmental Legislation and Audit	EEPE 44	2018	Understand the different types of acts that can be applied to reduce pollution
		Environmental Modeling Lab	EECP 03	2018	Develop a programme to design treatment plants
		Unit Operations and Processes laboratory	EECP 04	2018	Analyze the optimum cost-effective environmental treatment method

		Audit Course-II			
		Constitution Of India	**PGPA 21**	2018	To understand the growth of demands for civil rights in India. .
		Pedagogy Studies	**PGPA 22**	2018	The pedagogical practices being used by teachers in formal and informal classrooms in developing countries.
		Stress Management By Yoga	**PGPA 23**	2018	Develop healthy mind in a healthy body thus improving social health also
		Personality Development Through Life Enlightenment Skills	**PGPA 24**	2018	Develop personality and achieve the highest goal in life
		Mini Project	EEMP 01	2018	Identify environmental engineering problems reviewing available literature. Identify appropriate techniques to analyze complex environmental systems
M.Tech EE	1-1422777034	**Professional Elective- V**			
		Clean Technology	EEPE51	2019	Understand the different possible manufacturing methods can be applied to reduce pollution
		Mathematical Modeling in Environmental Engineering	EEPE52	2019	Apply mathematical modeling to give solution to environmental problems
		Environmental Management	EEPE53	2019	Understand the concepts of relation between environment and industries
		Climate Change	EEPE54	2019	Identify the different sources of pollution leading to climate change and

					suggest suitable control measures
		Open Elective- I			
		Business Analytics	EEOE 11	2019	Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
		Industrial Safety	EEOE 12	2019	Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
		Operations Research	EEOE 13	2019	Students should able to apply the dynamic programming to solve problems of discreet and Continuous variables.
		Cost Management of Engineering Projects	EEOE 14	2019	Students should able to apply the dynamic programming to solve problems of discreet and Continuous variables.
		Composite Materials	EEOE 15	2019	Students should able to apply the concept of non-linear programming
		Energy Generation from Waste	EEOE 16	2019	Demonstrate the energy generation from wastes
		Major project: Phase-I Dissertation	EEPD 01	2019	Identify environmental engineering problems reviewing available literature. Identify appropriate techniques to analyze complex environmental systems.

M.Tech EE	1-1422777034	Major project: Phase-II Dissertation	EEPD 02	2019	Identify environmental engineering problems reviewing available literature. Identify appropriate techniques to analyze complex environmental systems

Table. 1.3.1. Courses which Professional Ethics, Gender, Human values, Environment and Sustainability into the curriculum.

A. Professional Ethics:

Programme name	Programme code	Course name	Course code	Year of Introduction	Description of the course addressing Professional Ethics
M.Tech EE	1-1422777034	Environmental Legislation and Audit	EEPE 44	2018	Understand the different types of acts that can be applied to reduce pollution
		Environmental Impact Assessment	EEPE 41	2018	Able to asses different impacts for a proposed/ongoing/completed engineering project

B. Gender:

Programme name	Programme code	Course name	Course code	Year of Introduction	Description of the course addressing Professional Ethics
M.Tech EE	1-1422777034	--	--	--	-

C. Human values:

Programme name	Programme code	Course name	Course code	Year of Introduction	Description of the course addressing Professional Ethics
M.Tech EE	1-1422777034	Value Education	PGPA14	2018	acquire the knowledge of self-development

D. Environmental & Sustainability:

Programme name	Programme code	Course name	Course code	Year of Introduction	Description of the course addressing Professional Ethics
M.Tech EE	1-1422777034	Energy Generation from Waste	SEOE16	2019	Demonstrate the energy generation from wastes

I Semester

Semester	Components of Study	Course Name	Title of the Course	Credit hours per week	No. of Credits	IA Marks	End Semester Exam marks	Total
I	Core (Mandatory)	TEL 101	Prescribed Texts Classical Poetry & Drama	6	4	20	80	100
I	Core (Mandatory)	TEL 102	General Linguistics	6	4	20	80	100
I	Core (Mandatory)	TEL 103	History of Telugu Literature-I (Pre Nannaya to Srinadha Period)	6	4	20	80	100
I	Core (Mandatory)	TEL 104	Telugu Grammar and Prosody	6	4	20	80	100
I	Compulsory Foundation	TEL 105 A	Folk Lore	6	4	20	80	100
I	Compulsory Foundation	TEL 105 B	Sataka Sahityam	6	4	20	80	100
I	Compulsory Foundation	TEL 105 C	Special Study : Potana	6	4	20	80	100
I	Elective Foundation	TEL 106 A	Classical Telugu Genres	6	4	20	80	100
I	Elective Foundation	TEL 106 B	Pada Sahityam	6	4	20	80	100
I	Audit Course	TEL 107	Human Values and Profetional Ethics – 1	0	0	0	100	100

II Semester

Semester	Components of Study	Course Name	Title of the Course	Credit hours per week	No. of Credits	IA Marks	End Semester Exam marks	Total
II	Core (Mandatory)	TEL 201	Prescribed Texts: Modern Poetry	6	4	20	80	100
II	Core (Mandatory)	TEL 202	Evolution of Telugu Language	6	4	20	80	100
II	Core (Mandatory)	TEL 203	History of Telugu Literature-2 (Prabandha period to Modern Period)	6	4	20	80	100
II	Core (Mandatory)	TEL 204	Telugu Grammar and Poetics	6	4	20	80	100
II	Compulsory Foundation	TEL 205 A	Rayalaseema Sahityam	6	4	20	80	100
II	Compulsory Foundation	TEL 205 B	Comparitive Literatures	6	4	20	80	100
II	Compulsory Foundation	TEL 205 C	Special Author : Potuluri Veerabrahmam	6	4	20	80	100
II	Elective Foundation	TEL 206 A	Modern Telugu Genres	6	4	20	80	100
II	Elective Foundation	TEL 206 B	Samsthana Sahityam	6	4	20	80	100
II	Audit Course	TEL 207	Human Values Professional Ethics-II	0	0	20	80	100

III Semester

Semester	Components of Study	Course Name	Title of the Course	Credit hours per week	No. of Credits	IA Marks	End Semester Exam marks	Total
III	Core (Mandatory)	TEL 301	Classical Literary Criticism	6	4	20	80	100
III	Core (Mandatory)	TEL 302	Telugu Culture	6	4	20	80	100
III	Generic Elective	TEL 303 A	Telugu Journalism	6	4	20	80	100
III	Generic Elective	TEL 303 B	Modern Telugu Literature	6	4	20	80	100
III	Generic Elective	TEL 303 C	Telugu Feministic Literature	6	4	20	80	100
III	Generic Elective	TEL 303 D	Special Author : Gurajada	6	4	20	80	100
III	Skill Oriented course (Mandatory)	TEL 304	Personolity Developmet & Language Skills	6	4	20	80	100
III	Open Elective	TEL 305 A	Introduction of Telugu Literature	6	4	20	80	100
III	Open Elective	TEL 305 B	Fundamentals of Modern Telugu Language	6	4	20	80	100

IV Semester

Semester	Components of Study	Course Name	Title of the Course	Credit hours per week	No. of Credits	IA Marks	End Semester Exam marks	Total
IV	Core (Mandatory)	TEL 401	Modern Telugu Literary Criticism	6	4	20	80	100
IV	Core (Mandatory)	TEL 402	Sanskrit Literature and Grammar	6	4	20	80	100
IV	Generic Elective	TEL 403 A	Methods of Translation	6	4	20	80	100
IV	Generic Elective	TEL 403 B	Research Methodology	6	4	20	80	100
IV	Generic Elective	TEL 403 C	Telugu Dalith Literature	6	4	20	80	100
IV	Generic Elective	TEL 403 D	Indian Literature	6	4	20	80	100
IV	Multi Disciplinary Course (Mandatory)	TEL 404	India : A Phylosophical, Sociological & Historical Study	6	4	20	80	100
IV	Open elective	TEL 405 A	Fundamentals of Folk Lore	6	4	20	80	100
IV	Open elective	TEL 405 B	Telugu Nataka Sahityam	6	4	20	80	100

SRI VENKATESWARA UNIVERSITY:: TIRUPATI

SVU COLLEGE OF SCIENCES

DEPARTMENT OF GEOGRAPHY



Syllabus for M.Sc. GEOGRAPHY

Choice Based Credit System (CBCS)

(w.e.f. the Academic Year 2021-2022)

Vision

- The Department of Geography will promote academic. Research, Employment, community development.
- We will provide a rigorous educational experience through innovative teaching, Research Programmes and employment opportunities in IT Industry.
- We will increase our visibility as a research department through faculty scholarship, research grant activities, international collaborations and fellowships for research scholars
- To update curriculum for competitive Examinations, Research linkage with Industries.

Mission

- To provide educators with effective and relevant professional development, support, and materials focusing on geographic concepts, content, and pedagogy.
- To educate legislators and education decision-makers at the local, state and national levels about the relevance of geography in the 21st century and to motivate and inspire action within the context of curriculum design, professional development, connections between elementary, secondary, and university systems, and professional associations.
- To cultivate awareness among parents of students and the public at large of the importance of geo-literacy and to actively engage citizens in the development of geo-literacy and the institutional structures that will support this mission.

Programme Specific Outcomes

- Compare and discusses the formation of large scale landforms involving both exogenous and endogenous processes.
- Know how human, physical and environmental components of the world interact.

M.Sc. Geography 2021-22

SEMESTER - I

Sl. No	Components of Study	Title of the course	Title of the Paper	Contact hours	No. of Credits	IA Marks	End SEM Marks	Total
1.	Core Theory **(Mandatory)**	GEG - 101	Geomorphology	6	4	20	80	100
2.		GEG - 102	Cartography	6	4	20	80	100
3.	Compulsory foundation **(opt - 1)**	GEG – 103(A)	Economic Geography	6	4	20	80	100
		GEG – 103(B)	Human Geography					
		GEG – 103(C)	Environmental Geography					
4.	Elective foundation **(Opt - 1)**	GEG – 104(A)	Oceanography	6	4	20	80	100
		GEG – 104(B)	Computer Basics for Geography					
		GEG – 104(C)	Regional Geography of Andhra Pradesh					
5.	Practical - 1	GEG – 105	Map Projections	8	4	---	100	100
6.	Practical - 2	GEG – 106	Techniques of Mapping and map analysis	8	4	---	100	100
	TOAL			**40**	**24**	**80**	**520**	**600**
7.	AUDIT COURSE		Human Values and Professional Ethics- I	0	0	100	0	0

SEMESTER - II

Sl. No	Components of Study	Title of the course	Title of the Paper	Contact hours	No. of Credits	IA Marks	End SEM Marks	Total
1.	Core	GEG - 201	Climatology	6	4	20	80	100
2.	**(Mandatory)**	GEG - 202	Geographical Thought	6	4	20	80	100
3.	Compulsory Foundation **(Opt - 1)**	GEG – 203(A)	Principles of Remote Sensing	6	4	20	80	100
		GEG – 203(B)	Geography of Tourism					
		GEG – 203(C)	Industrial Geography					
4.	Elective foundation **(Opt - !)**	GEG – 204(A)	Physical Geography of India	6	4	20	80	100
		GEG – 204(B)	Regional Geography of India					
		GEG – 204(C)	Social and Cultural Geography					
5.	Practical - 1	GEG – 205	Interpretation of Topographical (S.O.I., U.S and O.S) and Weather Maps	8	4	---	100	100
6.	Practical - 2	GEG – 206	Research Techniques		4	---	100	100
	TOAL			**40**	**24**	**80**	**520**	**600**
7.	AUDIT COURSE		Human Values and Professional Ethics- II	0	0	100	0	0

SEMESTER - III

Sl. No	Components of Study	Title of the course	Title of the Paper	Contact hours	No. of Credits	IA Marks	End SEM Marks	Total
1.	Core **(Mandatory)**	GEG – 301	Urban Geography	6	4	20	80	100
2.		GEG – 302	Geographical Information System (GIS)	6	4	20	80	100
3.	Generic Electives **(Opt - 1)**	GEG – 303(A)	Agricultural Geography	6	4	20	80	100
		GEG – 303(B)	Transport geography					
		GEG – 303(C)	Disaster Management Studies					
4.	Practical	GEG – 304	Geographical Information System (GIS)	8	4	---	100	100
5.	Skill Oriented Course **(Mandatory Theory & practical)**	GEG – 305	GPS Survey and Report	Theory (2)+ Practical's(4)	4	10	90 (40+50)	100
6.	Open Elective **(Opt - 1)**	GEG – 306 (A)	Regional Geography of Andhra Pradesh	6	4	20	80	100
		GEG – 306 (B)	Geographical Information System (GIS) & Global Positioning System (GPS) and Applications					
	TOAL			**24**	**24**	**90**	**510**	**600**

SEMESTER - IV

Sl. No	Components of Study	Title of the course	Title of the Paper	Contact hours	No. of Credits	IA/Viva Marks	End SEM Marks	Total
1.	Core **(Mandatory)**	GEG – 401	Regional Planning	6	4	20	80	100
2.		GEG – 402	Advanced Remote Sensing	6	4	20	80	100
3.	Generic Electives **(Opt - 1)**	GEG – 403(A)	Water and Soil Resources Management	6	4	20	80	100
		GEG – 403(B)	Political Geography					
		GEG – 403(C)	Research in Geographical Studies					
4.	Practical	GEG = 404	Remote Sensing Applications	8	4	---	100	100
5.	Multi Disciplinary course/Project Work	GEG – 405	Project Work and Viva Voce	0	4	20	80	100
6.	Open Elective **(Opt - 1)**	GEG – 406 (A)	Regional Geography of India	6	4	20	80	100
		GEG – 406 (B)	Principles of Remote Sensing					
Total				**32**	**24**	**100**	**500**	**600**

SEMESTER – I
CORE THEORY – 1

GEOMORPHOLOGY

Learning Objectives

- To show the landforms, landscape evolution, various land forming processes with respect to time, climate and tectonic regimes, the course shall further convey an understanding on land forming processes with different Geomorphic agents and processes on different temporal and spatial magnitude.
- To understand the concept of place and how it is connected to people's sense of belonging to the physical environment, landscape and culture.
- To understand the fundamental concepts of spatial interaction and diffusion, which explain how human activities are influenced by the concept of distance.
- To exposed to the nature of physical systems such as geomorphologic processes and natural hazards.
- To read and interpret information on different types of physical features maps.
- To learn how human, physical and environmental components of the world interact.
- To Examine Earth's plate tectonic framework. Explain the relationship between earthquakes and volcanoes

Learning Outcomes

After the completion of the course, Students will be able to

- Explain principal terms, definitions and theories in geomorphology.
- Explain the interior structure of the earth and geological time scale.
- Assess the cause and effect of disturbances in/on the earth.
- Explain different theories and models for landscape evolution with time.
- Describes the landform and landform processes in different climatic zones and tectonic regimes.
- Compare and discusses the formation of large scale landforms involving both exogenous and endogenous processes.
- Know how human, physical and environmental components of the world interact.

P.T.O

SYLLABUS

Unit I Nature, Definition, Scope and recent trends in Geomorphology: Rocks Origin, Classification and distribution, Interior of the Earth. Geological time -scale.

Unit II Earth movements: Epierogenic and Orogenic earth movements. Theories of continental drift , Apostasy and plate tectonics. earthquakes, volcanoes and their distribution.

Unit III Geomorphic agents and Processes: Weathering, Erosion, Mass wasting. Concept of cycle of erosion, Davis and Penck concepts in the evolution of Landforms.

Unit IV Geomorphic Processes: Erosional and depositional landforms made by a) rivers, b) Glaciers, c) wind, d) underground water, e) waves & currents.

Suggested Readings:

1. Dayal, P. : A Text book of Geomorphology. Shukla Book depot, Patna, 1996.
2. Monkhouse, F.J. : Principles of Physical Geography, Hodder and Stoughton, London, 1960.
3. Sparks, B.W. : Geomorphology, Longmans, London, 1960.
4. Strahler, A.N. and Strahler, A.H. : Modern Physical Geography : John Wiley & Sons, Revised edition 1992.
5. Thornbury, W.D.Principles of Geomorphology, Wiley Eastern, 1969.
6. Wooldridge, S.W. and Morgan, R.S. : The Physical Basis Geography– An outline of Geomorphology, Longman Green & Co, London, 1959.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	3	-	2	2	3	3
CO_2	3	3	3	3	3	3	3	-	2	2	3	3
CO_3	3	3	3	3	3	3	3	-	2	2	3	3
CO_4	3	3	3	3	3	3	3	-	2	2	3	3

CORE - THEORY-2

GEG 102: CARTOGRAPHY

Learning Objective

- To apprise the students to various aspects of cartography.
- To introduce the basic concepts and key theoretical approaches in Advanced Cartography.
- To describes the art and science of map making and map analysis.
- To teach the representation and conversions of scales.
- To provide the knowledge on map design, layout, lettering, toponomy, drawing surface and equipment.
- To give the clear picture on the changing process of map making from analogue to digital.

Learning Outcomes

After the completion of the course, Students will be able to

- Explain the importance of advanced cartography in map making and presenting.
- Acquire good knowledge about different procedure of map making and various projection system of map making by developing broad knowledge about latitude, longitude, meridians, parallels etc.
- Developing their quantitative application in geographical study which gives more accuracy in any geographical enquiry which can further helps students in conducting research activities.
- Perform map layout and map interpretation for any geographical area.
- Acquire knowledge of different method of surveying and map making by using proper tools and technique and can apply this knowledge in future research works.

P.T.O

SYLLABUS

Unit I Cartography –Definition. Cartography is a science of human communication; Scales – Methods of representation & conversions; Map projections –classification and choice of projections. Merits and demerits of cylindrical, conical, zenithal and conventional projections.

Unit II Semiology – Kinds of symbols– Mapping qualitative and quantitative point, Line and Area symbols. Types of maps and their uses. Topographical maps: Elements of topographical maps, scales and numbering of Toposheets.

Unit III Map design and layout – Theory of visual perception constraints and Restrictions in map design. Lettering and Toponomy. Mechanics of map construction: Drawing surfaces – Drawing Equipment.

Unit IV Mapping the qualitative and quantitative data. Thematic mapping; concept of map base, map compilations & generalizations. Concepts of Geographical Information System (GIS).

Suggested Readings

1. Khan, Z.A. : Text book of practical geography, concept, New Delhi, 1998.
2. Monkhouse, F.J. & Wilkinson, H.R. : Maps and Diagrams, Methuen, London, 1994
3. Steers, J.A. : Map Projections, University of London Press, London Burrough,P.A. : Principles of geographic information systems for land resource assessment, Oxford University Press, New York, 1986.
4. Fraser Taylor D.R. : Geographic Information Systems, Pergaman Press, Oxford, 1991.
5. Star J and J. Estes : Geographic information systems. An introduction, Prentice Hall, Englewood Cliff, New Jersy, 1994.
6. Misra, R.P. and Rames, A.: Fundamentals of Cartography, Mcmillan Co., New Delhi, 1986.
7. Robinson, A.H. et al.: Elements of Cartography, John Wiley & Sons, U.S.A., 1995.
8. Sarkar, A.K., Practical Geography : A systematic approach; Oriental Longman, Calcutta, 1997.
9. Singh, R.L. and Dutt, P.K. Elements of Practical Geography, Kalyani publishers, New Delhi, 1979.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	1	2	2	2	3	1	2	2	3	3
CO_2	3	3	1	2	2	2	3	1	2	2	3	3
CO_3	3	3	3	3	1	3	3	1	1	3	3	3
CO_4	3	3	3	3	1	3	3	1	1	3	3	3

COMPULSORY FOUNDATION (OPT - 1)
GEG 103(A): ECONOMIC GEOGRAPHY

Learning Objectives

- To acquire knowledge about the concepts of resources, classification, models of natural resource processes, their use and misuse, conservation and management of resources for sustainable development
- To Provide a comprehensive introduction to basic concepts and key theoretical approaches in economic geography
- To Introduce economic geography as a dynamic, diverse and contested body of knowledge
- To enable you to apply this knowledge to key social and economic issues in the context of economic globalization
- To encourage to think about policy options for overcoming inequality and uneven development in the globalizing world.

Learning outcomes

After the completion of the course, Students will be able to

- Explain the importance of economic geography in analyzing the societies and economies work.
- Explain and apply key concepts and theoretical approaches in economic geography.
- Discuss and critically evaluate these concepts and theoretical approaches.
- Students will become sensitized to concept of resources.
- Students will become sensitized the classification of resources.
- Learn about use and misuse of resources.
- Will learn conservation methods and techniques.
- Showing an awareness and responsibility for the environment.
- Apply these concepts and theoretical approaches to key social and economic issues in the context of global economy.
- Discuss policy options for overcoming inequality and uneven development in the globalizing world.

P.T.O

SYLLABUS

Unit I Scope, content and recent trends in economic geography, relation of economic geography with economics and other branches of social sciences, classification of economies; sectors of economy (Primary, secondary and tertiary).

Unit II Natural resources: Nature and classification – renewable and non - renewable, biotic and abiotic, conservation of resources, changing nature of economic activities; mining, forestry, agriculture, industry, trade and transport.

Unit III Agricultural Resources: Spatial distribution of major food and cash crops of the world (rice, wheat, coffee, tea).Minerals resources- Classification of minerals (ferrous and non- ferrous).Major industries: Iron and Steel, Textiles, ship - building and their distribution

Unit IV Industrial location theory– Alfred Weber: Geographical factors in the development of major industries. Industrial policy of state and central government.

Suggested Readings:

1. Boesch, H. : A Geography of World Economy, D. Van Nostrand Co., New York, 1964.
2. Chapman, J.D. : Geography and Energy, Longman, London, 1989.
3. Gregor, H.F. : Geography of Agriculture, Prentice Hall, New Jersey, USA, 1970.
4. Griggs, D.B. : The Agricultural Systems of the World, Cambridge University Press, New York, 1974.
5. Hartshome, T.N. and Alexander, J.W. : Economic Geography, Prentice Hall, New Delhi, 1988.
6. Jones, C.F. and Darkenwald, G.G. : Economic Geography, McMilan Co., New York, 1975.
7. Millar E.: Geography of Manufacturing, Prentice Hall, New York, 1962.
8. Raza, M. and Agrawal, Y. : Transport Geography of India, Concept, New Delhi, 1986.
9. Smith, D.M. : Industrial Location – An Economic Geographical Analysis, John Willey, New York, 1971.
10. Thomas, R.S. : The Geography of Economic Activities, McGraw Hill, New York, 1962.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	3	1	3	1	3	3	1	3	3	3	3
CO_2	2	3	1	3	3	3	1	1	3	3	3	3
CO_3	1	3	3	1	1	1	3	3	1	3	3	3
CO_4	3	3	1	1	3	3	3	1	1	3	3	3

103 (B): HUMAN GEOGRAPHY

Learning Objective

- To apprise the students to various aspects of human resources and their importance.
- Provide a comprehensive introduction to basic concepts and key theoretical approaches in Population.
- To describe Describes migration and its impact on the regional human resources.

Learning Outcomes

After the completion of the course, Students will be able to

- Apprise the students to various aspects of human resources and their importance.
- Illustrate basic concepts and key theoretical approaches in population.
- Describes migration and its impact on the regional human resources.

SYLLABUS

UNIT I Definition, nature, origin and scope of human geography. Origin and evolution of human settlements.

UNIT II The patterns of population distribution of the world and India. Factors affecting the patterns of population distribution. Population Density.

UNIT III Trends of population growth of the world and India in the 20th century. Theories of population: Malthusian theory and Demographic Transition Theory.

UNITIV: Migration: Definition, types of migration internal and external, causes and Consequences of Migration, theories of migration – Lees theory. Problems and prospects of population growth; population policy and planning in India.

Suggested Redings :

1. Garnier, B.J: Geography of population, Long man group ltd., London, 1966
2. Bogue Donald.: Principles of Demography,JohnWiley and Sons, Newyark 1969.
3. Chandana R.C,: A Geography of population – Concepts , concepts, determinants, Kalyani publishers, New Delhi, 1986.
4. Clark, John,I(E.d): Geography and population :Approaches and applications, Pergman press ltd. Oxford 1984.
5. Mamoria, C.B.India's population problem, Kithab mahal, New Delhi,1981.
6. Srinivasan, K.Basic demographic techniques and applications, Sage publications , New Delhi ,1998.
7. Zelinsky Wilbur, A prologue of population of population Geography, prentice Hall , 1966.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	3	-	2	2	3	3
CO_2	3	3	3	3	3	3	3	-	2	2	3	3
CO_3	3	3	3	3	3	3	3	-	2	2	3	3
CO_4	3	3	3	3	3	3	3	-	2	2	3	3

GEG 103 (C): ENVIRONMENTAL GEOGRAPHY

Learning objectives:

- To create the environmental aptitude among students.
- To familiarize the students with concepts, issues, approaches about physical and social environment.
- To acquainted with contemporary environmental problems and challenges.
- To provide knowledge on Ecosystem, Biomes, food chain and hydrological cycle.

Learning Outcomes

After the completion of the course, Students will be able to

- Gain the knowledge on environmental aptitude
- Familiarize with concepts, issues, approaches about physical and social environment.
- Acquainted with contemporary environmental problems and challenges.
- Familiarized the knowledge on Ecosystem, Biomes, food chain and hydrological cycle.

SYLLABUS

UNIT I Nature, Scope and Significance of Environmental Studies; Concepts of Ecology, Ecological balance and the need for Ecological Approach.

UNIT II Concepts of Ecosystem : Structure, Classification and functioning of the ecosystem, Biomes, food web, food pyramid, Nutrient cycle, hydrological cycle.

UNIT III Impact of population growth on ecosystem. Agriculture, green revolution, HYV and pesticides. Man's impact on land, mining, coastal areas and transport.

UNIT IV Environmental impact assessment, Environmental reconstruction, management and planning, the need for interdisciplinary approach. The Role of GIS and Remote Sensing in Environmental Management.

Suggested Readings

1. Turk. : Introduction to Environment Studies, Sanndora, 1980.
2. Detwyler : Man's Impact on Environment, 1971.
3. Strahler & Strahler, Geography of Man's Environment Wiley, 1977.
4. Bennet : Man and Earth's Ecosystem, Wiley, 1975.
5. Leopoid and Lune (Ed) : A procedure for evaluating environmental impact.
6. Savindra Singh : Environmental geography– Prayagpustak Bhavan, Allahabad, 2000.
7. Dikshit, R.D.: Geography and Teaching of the environment, geography department, Poona University, 1984.
8. Agarwal, D.P. Man and Environment in India through ages, Book & Books, 1992.
9. Gaur, R. : Environment and Ecology of Early Man in Northern India, R.B. Publication Corporation, 1987. Hoyt, J.B. Man and the Earth, Prentice Hall, U.S.A.; 1992.
10. Singh, S. : Environmental Geography, Prayag Publications, Allahabad, 1991.
11. Smith, R.L. : Man and his Environment : An Ecosystem approach, Harper & Row, London, 1992.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	3	1	2	2	2	3
CO_2	3	3	3	3	3	3	3	1	2	2	2	3
CO_3	3	3	3	3	3	3	3	1	2	2	2	3
CO_4	3	3	3	3	3	3	3	1	2	2	2	3

GEG 104(A): OCEANOGRAPHY

Learning objectives:

- To develop the understanding about concepts associated with hydrosphere with context to oceanic relief, surfaces and their distribution on earth.
- To provide the knowledge about physical principles, characteristics, oceanic deposits.
- To develop knowledge on the ocean currents and their movemental impact. .

Learning Outcomes

After the completion of the course, Students will be able to

- Examine and compare the different ocean and water bodies with their distinct oceanic bottom relief, circulation system and marine deposits
- Improve the knowledge on Coral reefs and their formation theories..

SYLLABUS

UNIT 1 Oceanography – nature, scope and development, distribution of land and Water.Relief of Ocean Basins – Hypsometry. The Continental Shelf, The Continental Slope, the Deep Sea Plains, Submarine Canyons – Characteristics, Origin and Distribution. General features of Bathymetry bottom relief of Pacific, Atlantic and Indian Ocean.

UNIT II Ocean water: Distribution of temperature, composition of salinity, density of sea level.

UNIT III Ocean currents: origin, causes and characterises; Atlantic, Indian, Pacific Ocean. Tides and waves.

UNIT IV Ocean deposits: sources, types and distribution of ocean deposits. Coral reefs: formation types, factors of growth.

Suggested Readings:

1. Davis, R.J.A. 1986, Oceanography – An Introduction of the Marine Environment, Win C. Brown, Iowa.
2. King, C.A., Oceanography for Geographers, Edward Arnold Pub.
3. Murray, S.J., 1913, Ocean, A General account of the Science of the sea, Thorton Butter Worth, London.
4. Siddhartha, K. 1999, Oceanography, A Brief Introduction, Kisalaya Pub. Pvt. Ltd., New Delhi..
5. Singh, S. 2002, Physical Geography, Prayag Pub., Allahab6.Sharma & Vatal :
6. Oceanography for Geographers Chaitanya Publishing House, Allahabad.
7. Lal.D.S. Oceanography, chaitanya Publishing House, Allahabad,1994

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	1	3	3	3	3	3
CO_2	3	3	3	3	3	3	1	3	3	3	3	3
CO_3	3	3	3	3	3	3	1	3	3	3	3	3
CO_4	3	3	3	3	3	3	1	3	3	3	3	3

GEG 104 (B): COMPUTER APPLICATIONS IN GEOGRAPHY

Learning objectives:

- To develop the understanding about concepts associated computer applications and geographical relevance.
- To provide the knowledge about principles, characteristics of various computer programmes.
- To develop knowledge on how to use computers for geographical representations.

Learning Outcomes

After the completion of the course, Students will be able to

- Understand computer concepts and principles.
- Examine and compare the different computer programmes and usage of computers to geographical studies
- Improve the knowledge on computer net workings

SYLLABUS

UNIT I Introduction to computers , Definition, origin and Evolution, Characteristics, Limitations and Elements of Computers, Hard ware and Software.

Unit II M.S Office: M.S word and word processing – parts of word processecing, Moving and copying Window Toolbars, Creating, saving and closing Document- opening and editing of document text and Paragraph forming, Appling bullets and numbering, Creation of Table.

Unit III M.S.Excel: Features of M.S Excel-Spread sheet/work sheet, parts of M.S.Excel window Insertion and deletion of worksheet. Entering and editing date in work sheet. Different type of Function available in M.S.Excel -Templates, Charts, Graphs. Understanding Website and LAN

Unit IV Representation of Geographical Data Base: Rain fall, Temperature, Population, Crop Yielding, Land use and Land Cover. Tables, Graphs, Diagrams, Maps and PPT presentation.

Suggested Readings:

1. Fundamentals of Computer(First Edition- 2009) Publisher: McGraw-Hill by Balaguruswamy
2. Computer Fundamentals(Fourth Edition- 2007) Publisher: BPB Publications by Pradeep Sinha and Priti Sinha.
3. Computer Fundamentals(First Edition-2010) Publisher: Pearson by Anita Goel
4. Introduction to Computers (First Edition 2008) Publisher : Cengage Learning By Gary B.Shelly, Thomas J. Cashman and Misty E. Vermaat
5. Fundamentals of Computers and Programming with C by A. K. Sharma DhanpatRai publications
6. Computer Networks (4th Edition) by Andrew S. Tanenbaum
7. Operating System Concepts, (6th Edition) by Abraham Silberschatz, Peter Baer Galvin, Greg Gagne

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	2	1	3	3	1	2	2	3	3
CO_2	3	3	3	2	1	3	3	1	2	2	3	3
CO_3	3	3	3	2	1	3	3	1	2	2	3	3
CO_4	3	3	3	2	1	3	3	1	2	2	3	3

GEG 104(C): REGIONAL GEOGRAPHY OF ANDHRA PRADESH

Learning objectives:

- To acquaint the students with re- organization of Andhra Pradesh and its new physical, climate and drainage aspects. .
- To obtain the knowledge of demographic, irrigation and major crops.
- To understand Andhra Pradesh mineral and industrial aspects with transportation.
- To improve knowledge on the transportation and communication aspects of Andhra Pradesh

Learning Outcomes

After the completion of the course, Students will be able to

- Understand re- organization of Andhra Pradesh and its new physical, climate and drainage aspects. .
- Obtain the knowledge of demographic, irrigation and major crops.
- Understand Andhra Pradesh mineral and industrial aspects with transportation.
- Improved knowledge on the transportation and communication aspects of Andhra Pradesh

SYLLABUS

UNIT I: Re-organization of Andhra Pradesh Act -2014 Location and physical setting Major Physiographic Divisions– Soils, Vegetation, and Drainage – Climate Regions and their Characteristics.

UNIT II Population Distribution; Density, growth and problems. Agriculture Types. Irrigation and power; Multipurpose Projects, Major food grain crops.(Paddy, Jower and Ragi), major Commercial Crops (Cotton, Groundnut and Mango).

UNIT III Mineral Resources: Iron ore, Limestone and Petroleum, Industries: Iron and Steel, Cotton and IT. Industrial Regions and Special Economic Zones (SEZ) Andhra Pradesh.

UNIT IV Transportation and Communication – Road, Rail, Water (special reference to coastal Transport) and Air Transport. Communication net work in Andhra Pradesh.

Suggested Readings:

1. Take from 401, 4, 5 from old syllabus.
2. Structure, growth and prospects of Industries in Andhra Pradesh. Lotus publications, Varanasi-1989.
3. Regional Geography of Andhra Pradesh– Telugu Academy.
4. Andhra Pradesh year book -2010 -2015.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	2	3	2	1	3	2	2	3
CO_2	3	3	3	3	2	3	2	1	2	2	2	3
CO_3	3	3	3	3	2	3	2	1	3	2	2	3
CO_4	3	3	3	3	2	3	2	1	2	2	2	3

Practical – 1
GEG 105: MAP PROJECTIONS

Learning Objective

- To apprise the students about the art and science of map making and representation.
- To explains the usage of different types of projections
- To focus on the importance of scale and projection in the process of representing the earth surface

Learning Outcomes:

After the completion of the course, Students will be able to

- Explain the concept of map, scale and projection
- Student can explain the purpose of projection
- The main outcome of this course is students can able to select different projection for different geographical areas.

SYLLABUS

Unit I Introduction to Map projections; Zenithal Projections: Equi -distant; Equal area, Stereo graphics, Gnomonic.

Unit II Cylindrical Projections: Equi -distant, Equal area, Mercator, UTM, Gall's Projection

Unit III Conical Projections: One standard parallel, Two standard parallel; Bonne's, Polyconic.

Unit IV: International map projection: Sinusodial, interrupted. Sinusoidal Molweides; Interrupted – Molweides projections.

Suggested Readings

1. Khan, Z.A. : Text book of practical geography : concept; New Delhi, 1998.
2. Misra, R.P. and Ramesh, A. : Fundamentals of Cartography, Concept, New Delhi, 1989.
3. Singh, R.L. : Map work and practical geography; central book depot; Allahabad, 1972.
4. Steers, J.A. : Map projections, University of London Press, London

Practical – 2

GEG 106: TECHNIQUES OF MAPPING AND MAP ANALYSIS

Learning Objective

- To apprise the students about the Terrain mapping techniques
- To project the representation of the landforms by using contour lines
- To explains the methods of slope analysis
- To develop the knowledge on the thematic maps
- To Understand the data representation through the diagrammatic form and log graphs

Learning Outcomes

After the completion of the course, Students will be able to

- Students can able to Represent the landforms with contour lines
- Student can perform profiles which are drawn from landforms through contours
- Student can represent the slope analysis models
- Students can able to understand how to represent the data through different diagrams and graphs

SYLLABUS

. UNIT I Interpolation of contours. Landforms represented by contours. Profiles: Serial, Superimposed, Projected, Composite.

UNIT II Slope Analysis: Smith's and Wentworth's Methods.

UNIT III Thematic mapping: Dot method, Isopleths and Iso –Chromatic method; Choropleth and Choro-Chromatic methods; Flow method.

UNIT IV Bar Diagrams: Simple, Compound, Superimposed, Graphs: Trilinear, Semi log;Log-log., Diagrams -Pyramid, Pie. Hyther-graph, Climo-graph, Ergo-graph, Band–graph. Frequency polygon.

Suggested Readings

1. Misra, R.P. and Ramesh, A. : Fundamentals of Cartography, concept, New Delhi,1989.
2. Monkhouse, F.J.H.R. and Wilkinson: Maps and diagrams; Methuen and Co.,London,1984.
3. Peter Toyne & Peter Newby, T.: Techniques in human geography; MacMillan,London, 1972.
4. john Byogott: An introduction to map work and practical geography, universityTutorial press Ltd., London .

Audit Course

HUMAN VALUES AND PROFESSIONAL ETHICS – I

Unit I Definition and Nature of Ethics – its relation to Religion, Politics, Business, Law, Medicine and Environment. Need and Importance of Professional Ethics-Goals – Ethical Values in various Professions.

Unit II Nature of Values-Good and Bad, Ends and Means, Actual and potential Values, Objective and Subjective Values, Analysis of basic moral concepts right, ought, duty, obligation, justice, responsibility and freedom, Good behavior and respect for elders, Character and Conduct.

Unit III Individual and society: Ahimsa (Non-Violence), Satya (Truth), Brahmacharya (Celibacy), Asteya (Non Possession) and Aparigraha (Nonstealing).Purusharthas (Cardinal virtues)- Dharma (Righteousness), Artha (Wealth), Kama (Fulfillment Bodily Desires), Moksha (Liberation).

Unit IV Bhagavad Gita – (a) Niskama karma. (b) Buddhism – The Four Noble Truths – Arya astanga marga, (c) Jainism – Mahavratas and anuvratas. Values Embedded in Various Religions, Relirious Tolerance, Gandhian Ethics.

Unit V Crime and Theories of punishment – (a) Reformative, Retributive and Deterrent. (b) Views on manu and Yajnavalkya.

Suggested Readings:

1. John S Mackenjie: A Manual of ethics.
2. "The Ethics of Management": by Larue Tone Hosmer, Richard D. IrwinInc.
3. "Management Ethics – integrity at work" by Joseph A. Petrick and John F. Quinn, Response Books: New Delhi.
4. "Ethics in Management" by S.A. Sherlekar, Himalaya Publishing House.
5. Harold H. Titus: Ethics for Today.
6. Maitra, S.K: Hindu Ethics.
7. William Lilly: Introduction to Ethics.
8. Sinha: a Manual of Ethics.
9. Manu: Manu Dharma Sastra or the institute of Manu: Comprising the Indian system of Duties: Religious and Civil(ed) G.C. Haughton.
10. Susruta Samhita: Tr. Kaviraj Kunjanal, Kunjanal Brishagratha, Chowkamba Sanskrit Series. Vol. I,II,III, Varanasi VOL. I OO, 16-20, 21-32, and 74-77 only.
11. Caraka Samita: Tr. Dr. Ram Karan Sharma and Vaidya Bhagavan Dash, Chowkamba Sanskrit Series Office, Varanasi. I,II,III VOL. I, PP 183-191.
12. Ethics, Theory and Contemporary issues, Barbara Mackinnon, Wads Worth/Thomson Learning 2001.
13. Analyzing Moral issues, Judith A. Boss, Mayfield Publishing Company ,1999.
14. An Introduction to Applied Ethics (Ed.) John H. piet and Ayodhya Prasad, Cosmo Publications.
15. Text book for Intermediate logic, Ethics and Human Values, Board of Intermediate Education & Telugu Academic Hyderabad.
16. I.C Sharma Ethical Philosophy of India. Nagin & Co. Julundha

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2	2	2	3	2	2	1	2	2	2	2
CO_2	1	3	2	2	3	3	3	1	3	2	2	2
CO_3	2	1	3	2	2	1	2	1	2	2	2	2
CO_4	3	3	3	1	3	3	3	1	2	2	2	3

SEMESTER – II

CORE THEORY-1

GEG 201: CLIMATOLOGY

Learning Objective

- To introduce to the students the fundamentals of atmospheric phenomena, global climate systems and climate change.
- The atmosphere and climate are a critical part of the earth system, and climatic variability and change are central to the issue of current and future global environmental change.
- To grasp the techniques for modeling the climate, covering both theoretical and technical aspects.
- To understand the dynamics of the atmosphere and the overall climatologically system.
- To be able to analyse and interpret climatic data and classification of climate

Learning Outcomes

After the completion of the course, Students will be able to

- Obtain the knowledge on fundamentals of atmospheric phenomena, global climate systems and climate change.
- Understand the atmosphere and climate are a critical part of the earth system, and climatic variability and change are central to the issue of current and future global environmental change.
- Grasp the techniques for modeling the climate, covering both theoretical and technical aspects.
- Understand the dynamics of the atmosphere, the ocean and the overall climatologically system.
- Able to analyze and interpret climatic data and classification of climate

P.T.O

SYLLABUS

UNIT I Nature and scope of climatology. Composition and structure of the Atmosphere – Insulation – heat balance, green house effect – vertical and Horizontal, distribution of Temperature.

UNIT II Atmospheric Pressure – Pressure gradient – Pressure belts – vertical and Horizontal distribution of pressure – winds – monsoons and cyclones.

UNIT III Water vapor- Humidity – Relative, absolute and specific humidity – condensation and types, cloud types, types of Rainfall – Koppen's and Thornthwaite's scheme of climatic classification.

UNIT IV Theories of Climatic changes – Astronomical or Orbital Theory, Continent Displacement Theory. Micro Climates – agro climate, urban climate, global warming, heat Island, health hazards. Weather Forecasting - Problems and Prospects of weather Forecasting in India.

Suggested Readings

1. Crittch Field, J.H. : General Climatology, Prentice Hall, India, New Delhi, 1993.
2. Lal, D.S. : Climatology, Chaitanya Publishing House, Allahabad, 1986.
3. Garrison, T. : Oceanography – An introduction to Marine Science. Books / Cole, Pacific Groue, USA, 2001.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	2	2	3	2	1	2	2	2	3
CO_2	3	3	3	2	2	3	2	1	2	2	2	3
CO_3	3	3	3	2	2	3	2	1	2	2	2	3
CO_4	3	3	3	2	2	3	2	1	2	2	2	3

CORE THEORY-2

GEG 202: GEOGRAPHICAL THOUGHT

Learning Objective

- To acquaint the students with the Geographical philosophy. and the Methodology and historical development of geography as a professional field.
- The idea is to address the spirit and purpose of the changing geographies and to what we as geographers contribute towards knowledge production.
- To developing critical thinking and analytical approaches and Students will acquire an understanding of and appreciation for the contributions of the eminent geographers to the subject.
- To provide the knowledge on the quantitative revolution in the geographical studies.

Learning Outcomes

After the completion of the course, Students will be able to

- Understand the evolution of geography over the decades.
- Students will demonstrate an advanced understanding of the historical development of geographical studies.
- They can understand the major current philosophical and theoretical debates in geography.
- Students will demonstrate an understanding of current research within the breadth of geography, as well as more in depth knowledge of research in their specialty areas.
- Students will develop a solid understanding of the concepts of “space," “place” and “region” and their importance in explaining world affairs.
- Improve knowledge on the quantitative revolution in the geographical studies.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	2	1	3	2	3	3
CO_2	3	3	3	3	3	3	2	1	3	2	3	3
CO_3	3	3	3	3	3	3	2	1	3	2	3	3
CO_4	3	3	3	3	3	3	2	1	3	2	3	3

P.T.O

SYLLABUS

UNIT I Ancient Geography – Contributions of Greeks and Romans Medieval Geography– contributions of Arab Geographers, Modern Geography– Contribution of Immanuel Kant, Alexander Von Humboldt and Carl Ritter.

UNIT II Contributions of German Geographers : Friedrich Ratzel, Ferdinand Von Ritchthofen, Albrecht Penck and Alfred Hettner and French geographers: Vidal de la blache, Elisee Reclus, Jean Brunhes and Emmanual de Martonne. Asian geographers with special reference to Indian geographers

UNIT III Dualism in Geography-Systematic and regional Geography. Determinism and Possibilism; Geography as a natural science and social science.

UNIT IV Quantitative revolution– causes and consequences. Behavioral geography. Laws, Theories and Models in Geography.

Suggested Readings

1. Dikshit, R.D. (ed.) : The Art & Science of Geography – Integrated Readings, Prentice Hall of India, New Delhi, 1994.
2. Hartshome, R. : Perspective on nature of Geography, Rand MeNally & Co., 1959.
3. Husain, M. : Evolution of Geographic thought, Rawat Pub., Jaipur, 1984.
4. Minshull, R. : The Changing nature of Geography, Hutchinson University Library, London, 1970.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	3	1	3	2	3	3
CO_2	3	3	3	3	3	3	3	1	3	2	3	3
CO_3	3	3	3	3	3	3	3	1	3	2	3	3
CO_4	3	3	3	3	3	3	3	1	3	2	3	3

COMPULSORY FOUNDATION (OPT - 1)
GEG 203(A): PRINCIPLES OF REMOTE SENSING

Learning Objective

- To focus on history and evolution of Remote sensing.
- To explains the principle involved in remote sensing i.e. the Electromagnetic spectrum, reflection, refraction, diffusion, absorption and interaction with earth's atmosphere.
- To give the technical knowledge of satellite system.
- To provide knowledge on the platforms and instruments used for remote sensing.
- To give light on Areal Remote sensing and satellite Remote sensing.
- To explains about the specifications of sensors.

Learning Outcomes

After the completion of the course, Students will be able to

- Understand the principles of remote sensing and its techniques.
- Student will be able to know the apply the technique of remote sensing in varies fields.
- Student can apply the knowledge in getting authentic data by performing pre and post analysis in aerial remote sensing.
- Student will analysis the changes on earth surface with the image interpretation and visual interpretation techniques.
- With the sound knowledge on the process, principles, effecting factors, techniques of Remote sensing student can understand interpretation of the data in much more accurate.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	2	2	2	3	1	1	2	1	1	2
CO_2	3	3	2	2	2	3	1	1	2	1	1	2
CO_3	3	3	2	2	2	3	1	1	2	1	1	2
CO_4	3	3	2	2	2	3	1	1	2	1	1	2

P.T.O

SYLLABUS

UNIT I Introduction to Remote Sensing: History, Development and Principles. Stages in Remote sensing Process. Energy Sources and Radiation Principles-Energy Interaction in the Atmosphere. Atmospheric Windows. Energy Interaction with Earth Surface features. Electromagnetic Spectrum. Spectral reflectance patterns of Earth surface features in different wavelengths.

UNITII Thermal Remote Sensing: Thermal sensors and characteristics, Interpretation of thermal images, Emissivity conservation, Thermal inertia considerations, Factors effecting analysis of thermal images. Estimation of land surface temperature.

UNITII Microwave Remote Sensing: Microwave Remote Sensing and its advantages. Active and passive systems. Platforms and sensors. Active Microwave systems: Basic principles of radar, radar equation, Resolution, Range, Phase and Angular measurements, Microwave scattering and its measurement, Relationships between scene and sensor parameters. Imaging systems, Imagery – their characteristics and interpretation.

UNIT-IV. Satellite Remote Sensing: Types of Satellites, Orbits: Types of Orbits, and Orbital Characteristics. Platforms: types of Platforms in Remote sensing. Sensors-Definition,Types of Sensors in Remote sensing. Scanning mechanism. Resolutions: Definition, Spectral, Spatial, Temporal and Radiometric resolutions of Satellites. Characteristics of Indian Remote Sensing Satellites(I.R.S)

Suggested Readings

1. American Society of Photogrammetry : Manual of Remote Sensing, ASP, Falls Church, V.A. 1983.
2. Barrett, E.C. and L.F. Curtis : Fundamentals of Remote Sensing and Air Photo Interpretation, Mcmillan, New York, 1992.
3. Compbell, J. : Introduction of Remote Sensing, Guilford, New York, 1989.
4. Curran, Paul, J. : Principles of Remote Sensing, Longman, London, 1985.
5. Leuder D. : Aerial Photographic Interpretation: Principles and Application, McGraw Hill, New York, 1959.
6. Rao D.P. (eds.) : Remote Sensing for Earth Resources, Association of Exploration Geophysicist, Hyderabad, 1998.
7. Thomas M. Lillesand and Ralph W. Kefer, Remote Sensing and Image Interpretation. John Wiley & Sons, New York, 1994.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2	2	1	1	2	2	3	2	2	2	2
CO_2	2	2	2	1	1	2	2	3	2	2	2	2
CO_3	2	2	2	1	1	2	2	3	2	2	2	2
CO_4	2	2	2	1	1	2	2	3	2	2	2	2
CO_5	2	2	2	1	1	2	2	3	2	2	2	2

GEG 203(B): GEOGRAPHY OF TOURISM

Learning objectives:

- To provide introduction on Scope and subject matter of Tourism, Types of tourism. Tourism environment and Heritage.
- To give Knowledge on tourism and economic importance.
- To provide Understanding on Tourism and its Impact on Human Resources development.
- To provide knowledge on infrastructural and facilities development for tourism.

Learning Outcomes

After the completion of the course, Students will be able to

- Understand the evolution of tourism geography over the decades.
- Students will demonstrate understanding of the tourism and economic importance.
- They can understand the tourism impact on the HRD.
- Students will develop a concrete understanding of tourism and infrastructural need.

SYLLABUS

UNIT-I Tourism: Definition, nature and Scope Tourism. Types of tourism. Tourism environment and Heritage

UNIT-II Economic important of Tourism. status of national and the state of Andhra Pradesh in Tourism Development.

UNIT-III Human resource Development due to tourism -Apprenticeship, Training in Institutions of Computer Technology. Tourism as service based smokeless and non - export industry in India.

UNIT-IV Infrastructural development of Tourism and recreation - Accommodation, Food Facilities,Travel and Transport (palace on wheels), Drinking water, sanitation, security, banking, marketing and foreign exchange. Planning and policies of Tourism in India and Andhra Pradesh

Suggested Ridings:

1. Kaul,C.N; Dynamics of Tourism . A trilogy in three volumes sterling publishers1985.
2. Alister mathuson and Geefry hall – Tourism: Economic, Physical and social impact- longman, 1982.
3. Chib, som ,N.-perspectives on Tourism in India.
4. Bukart,A.J. and Medilik , S- Tourism: past , present and feature.
5. Norval , A.j . The tourist Industry.
6. PILLAI,R.N.- Tour and Pligrimage in India.
7. Ram ACHARYA- Tourism and cultural heritage of India.
8. KAUL.S.N –Tourism in India: all tourist Guide and Reference book 1977.
9. Negi J.M.S. Tourism and hotelring : A world wide industry 1982, New Delhi :Gitanjali. Publication
10. Bhatia ,A.K, - Tourism development :Principal and practices.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2	2	1	1	2	2	3	2	2	2	2
CO_2	2	2	2	1	1	2	2	3	2	2	2	2
CO_3	2	2	2	1	1	2	2	3	2	2	2	2
CO_4	2	2	2	1	1	2	2	3	2	2	2	2
CO_5	2	2	2	1	1	2	2	3	2	2	2	2

GEG203(C): INDUSTRIAL GEOGRAPHY

Learning objectives:

- To develop the understanding about industrial Geography.
- To familiarize the students with industrial location theories, in industrial geography.
- To provide knowledge on industrial classification.
- To enhance knowledge on industrial regions and imbalances in India.

Learning Outcomes

After the completion of the course, Students will be able to

- Understanding about industrial Geography.
- Can familiarize the students with industrial location theories, in industrial geography.
- Improve the knowledge on industrial classification.
- Enhance knowledge on industrial regions and imbalances in India.

SYLLABUS

UNIT I Definition, Nature and scope of industrial Geography, significance of Industrial Geography, Industries; Introduction and definition.

UNITII Major geographical factors for industrial locations. Theories of Industrial location: August Losch and Isard.

UNITIII Classification of Industries: Resource based, agro based, Information Technology (IT). Multitasked: Small scale and large scale industries.

UNIT IV Industrial Regions: Industrial development in India, Industrialization in Andhra Pradesh. Regional imbalances.

Suggested Readings:

1. Israd,W.: Introduction to regional sciences.Prentice Hall .
2. Smith,D.M. : Industrial location, willay international edition -1971
3. Alexander J.N.:Economic Geograpy. Prentice Hall.
4. Estall,R.C.& industrial activity and Economic Geography, R.O.Buchanan Hatchinson university libraray, London
5. SINHA,B.N. industrial geography of India
6. Thoman ,Concling and yeats:The Geography of Economic activity, M.c graw Hill company.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	3	1	3	3	3	3
CO_2	3	3	3	3	3	3	3	1	3	3	3	3
CO_3	3	3	3	3	3	3	3	1	3	3	3	3
CO_4	3	3	3	3	3	3	3	1	3	3	3	3

GEG204(A): PHYSICAL GEOGRAPHY OF INDIA

Learning objectives:

- To develop the understanding about physical features of Indian Geography.
- To familiarize the students with physiography, Drainage, Climate, soil and natural vegetation of India.

Learning Outcomes

After the completion of the course, Students will be able to

- Conceptualize the elements of physical features of Indian geography.
- Visualize and recognize the major topographical, geological, soil and natural vegetation regions of India.
- examine the various issues, problems and challenges associated with these physical regions.

SYLLABUS

UNIT I Physiography: Major Physiographic Divisions of India; Extra- Peninsula: Its Structure Relief and the Evidences Regarding its Present Day Evolution; Evolution, Structure and Relief; of Peninsula, Indo Gangetic Plain, Western Coast, Eastern Coast and Islands.

UNIT II Drainage System: Himalayan and peninsular drainage - The Indus, Brahmaputra, Ganga the Godavari and Krishna River Systems; differences between the Himalayan and Peninsular Drainage.

UNIT III Climate: Origin and Mechanisms of Indian Monsoon - Classical and Modern Views of origin; Effects of El-Nino and La-Nina on Indian Monsoon. Koppen's and Thornthwaite classification of Indian Climate.

UNIT IV Soils and Forest: classification, erosion and conservation; Saline and Alkaline Soils - measures of reclamation; Problems and developmental programs of Indian Forestry.

Suggested Readings:

1. Spate, O.H.K., & Learrmonth, A.T.A., India & Pakistan, London.
2. Puri, G.S., Indian forest Ecology, New Delhi.
3. Ray Chaudhary, S.P. Land and soil, New Delhi
4. The Gazetteer of India Vo 1,.1
5. Krishnan, M.B. : Geology of India, Higginbothams, Madras.
6. Das, P.K., The Monsoon, New Delhi
7. Wadia, D.N., Geology of India, London.
8. Memoria, C.B. : Economic and Commercial Geography of India, Shirlal Agarwaland Co., Agra, 1991.
9. Alam, S.M. : Planning atlas of Andhra Pradesh.
10. Khullar: India, A comprehensive Geography. Kalyani Publishers , New Delhi.1989.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	1	3	3	3	3	3	3	1	3	3	3	3
CO_2	2	1	3	3	2	3	3	1	3	3	3	3
CO_3	1	1	3	3	3	2	3	1	3	3	3	3
CO_4	3	3	1	3	3	3	3	1	3	3	3	3

GEG204(B): REGIONAL GEOGRAPHY OF INDIA

Learning objectives:

- To conceptualize the regional approaches and to examine regional differentiation in the study of Indian Geography.
- To expose to historical, economic, cultural, social and physical characteristics of India.
- To provide an introduction to the regions of the India in terms of both their uniqueness and similarities. .

Learning Outcomes

After the completion of the course, Students will be able to

- Developed the art of regionalization technique while focusing about diversity of Indian region.
- visualized and recognized about regional identities and socio-cultural dimension of regionalization to address the issues and concern needed for regional planning.

SYLLABUS

UNIT I Location and Regional Geographical Setting; Region; Development and Types- formal region, nodal region, functional region. Regionalization – Causes, methods and techniques used for regionalization.

Unit: II Mineral Resources – Coal, Iron ore and petroleum. Industries: Iron and Steel, Oil refinery and Paper industries; Industrial Regions of India.

Unit III Agriculture – Agriculture Types, Systems and Productivity. Regionalization of Agriculture - methods and techniques used in the analysis of crop combination regions. Agricultural policies in India

Unit IV Population; Distribution, Density growth and problems, population policies in India; Irrigation; Multipurpose projects. Power – Hydral, Thermal, Solar and Wind

Suggested Readings

1. Spate, O.H.K., & Learrmonth, A.T.A., India & Pakistan, London.
2. Puri, G.S., Indian forest Ecology, New Delhi.
3. Ray Chaudhary, S.P. Land and soil, New Delhi
4. The Gazetteer of India Vo 1,.1
5. Krishnan, M.B. : Geology of India, Higginbothams, Madras.
6. Das, P.K., The Monsoon, New Delhi
7. Wadia, D.N., Geology of India, London.
8. Memoria, C.B. : Economic and Commercial Geography of India, Shirlal Agarwal and Co., Agra, 1991.
9. Alam, S.M. : Planning atlas of Andhra Pradesh.
10. Khullar: India, A comprehensive Geography. Kalyani Publishers , New Delhi.1989.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	2	3	1	2	3	1	3
CO_2	2	2	2	2	3	3	2	1	3	2	3	3
CO_3	1	3	3	2	3	1	3	2	2	1	2	2
CO_4	3	1	3	3	1	3	2	1	3	3	3	3

GEG204(C): SOCIAL AND CULTURAL GEOGRAPHY

Learning objectives:

- To understand the theoretical emergence of social geography, social well being, gender issues, social differentiation and regional dimensions of sociological changes.
- To demographic, social and cultural attributes of Earth such as migration, social relations and cultural identity

Learning Outcomes

After the completion of the course, Students will be able to

- Assess the casual role of Geography in production of different social groups and shaping of their unique features.
- Evaluate the emerging social spaces, stratification, social well being, and issues of social justice through spatial perspective.

SYLLABUS

UNIT I Social Geography – Nature and Scope – Social Structure and processes – concept of space and place – social well being – quality of life – social exclusion and inclusion.

UNIT II Ethnicity, tribe, dialect, language, caste and religion - Spatial distribution- World and India.

UNIT III Cultural Geography- Nature and scope; culture complex and regions; cultural heritage, interactions, diffusion, ecology and imperialism.

UNIT IV India's Cultural Setting: Historical perspective of Indian culture; Racial, linguistic, ethic diversities and religious minorities; Inter-regional, intra-regional and international migration and associated problems; Health indicators.

Suggested Readings:

1. Robestein J.H. & Robert S. Barren (1990) the cultural Landscape An Introduction to Human Geography, Prentice Hall of India Pvt. Ltd. New Delhi – 1.
2. Singh R.Y. (2003) Geography of Settlements. Rawat Publications, Jaipur.
3. Hussain M. (1999) Human Geography, 2nd Edition, Rawat Publication, Jaipur .
4. TirthaRanjit (2002) Geography of India 2nd Edition, Rawat Publication, Jaipur.
5. www.fortunecity.com/victorian/updike/188.culture.
6. www.utexas.edu/depts/grg/sanders/GRG305/industrialgeography.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	2	3	2	2	3	3	3	1	3
CO_2	3	3	2	2	3	1	2	2	3	2	3	3
CO_3	1	3	1	2	3	3	3	2	2	1	3	3
CO_4	3	3	3	3	1	3	3	1	3	3	3	3

Practical - 1

GEG 205: INTERPRETATION OF TOPOGRAPHICAL(S.O.I., U.S and O.S) AND WEATHER MAPS

Learning objectives

- To provide understanding and interpretation Skills of different Topographical maps.
- To improve the knowledge on Indian weather maps and Interpretation skills.

Learning Outcomes

After the completion of the course, Students will be able to

- Explain the elements, scale and numbering of Topographical maps
- Analyse and interpret the physical and cultural features from Indian, U.S and O.S Toposheets.
- Explain the elements of weather maps and analyse and interpret the weather maps

SYLLABUS

UNIT I Indian Topographical Maps – Introduction, Numbering, importance, and usage

UNIT II Interpretation of physical features and cultural features Survey of India (SOI).

UNIT III Interpretation of physical features, cultural features U.S. and O.S. Toposheets.

UNIT IV Interpretation of Weather maps (India): elements and interpretation.

Suggested Readings

1. John Bygott : An introduction to map work and practical geography, UniversityTutorial Press Ltd., London, 1974.
2. Mishra, R.P. and Ramesh, A. : Fundamentals of Cartography, Concept, New Delhi,1989.
3. Singh, R.L.: Map work and practical geography, control Book depot, Al lahabad,1972.

Practical - 2

GEG 206: RESEARCH TECHNIQUES

Learning objectives

- To provide an understanding for the student on statistical concepts to include measurements of location and dispersion, and correlation analysis.
- To calculate and apply measures of location and measures of dispersion -- grouped and ungrouped data cases.
- To sensitize the different Research and agricultural techniques.

Learning outcomes:

After the completion of the course, Students will be able to

- Keeping in view the nature of data and purpose of study and to make a rational choice amongst listed various statistical methods.
- Students shall know how to organize, manage, and present data.
- Understand and use different research techniques in their researches and day to day needs.
- Use different agricultural methods in their research and needed situations.

SYLLABUS

UNIT I Frequency Distribution, Measures of Central Tendency; Arithmetic Mean, Median, Mode

UNIT II Measures of dispersion: Mean deviation, Quartile deviation, Standard deviation, Correlation- Rank Correlation

UNIT III Network analysis: Alfa, Beta, Gama, Eta, Theta indices, Centrality,Connectivity and shortest path matrix analysis.

UNIT IV Nearest neighbor distance analysis, Crop combination and Drainage basin Morphometry

Suggested Readings

1. Aslam Mahmood–Statistical Methods in Geographical Studies, Publication, New Delhi, 1977.
2. Cole, J.P. & King, DAM – Quantitative Methods in Geography, John Wiley andSons, New York, 1968.
3. Gregory, K.J. and Walling, D.E. Drainage basin form and process: AGeomorphologic approach; Amold; London 1973.
4. Peter Davis: Science in geography, Science Series– 3, Data description and presentation, Oxford University Press, London, 1975.
5. Peter Toyne and Peter Newby, T.: Techniques in Human geography, MacMillan, London, 1972.
6. Singh Jasbir and Dhillon, S.S. : A gricultural geography, TATA Mc Graw Hill,New Delhi, 1984.
7. Singh, R.L. Mapwork and practical geography, central book depot, Allahabad,1972.
8. Singh, R.L. Elements of Practical Geography, Kalyani Publishers, 1992.
9. Toyni, P. and Newby, Techniques of Map, Longman, London, 1965

Audit Course

HUMAN VALUES AND PROFESSIONAL ETHICS – II

Unit I Value Education –Definition – relevance to present day – Concept of Human Values – Self introduction – Self esteem. Family Values – Components, structure and responsibilities of family Neutralization of anger – Adjustability – Threats of family life – Status of women in family and society – Caring for needy and elderly – Time allotment for sharing ideas and concerns.

Unit II Medical ethics- views of Charaka, Sushruta and Hippocratus on moral responsibility of medical practitioners. Code of ethics for medical and healthcare professionals. Euthanasia, Ethical obligation to animals, Ethical issues in relation to health care professionals and patients. Social justice in health care, human cloning, problems of abortion. Ethical issues in genetic engineering and Ethical issues raised by new biological technology or knowledge.

Unit III Business ethics- Ethical standards of business-Immoral and illegal practices and their solutions, Characteries of ethical problems in management, ethical theories, causes of unethical behavior, ethical abuses and work ethics.

Unit IV Environmental ethics- Ethical theory, man and nature – Ecological crisis, Pest control, Pollution and waste, Climate change, Energy and population, Justice and environmental health.

Unit V Social ethics- Organ trade, Human trafficking, Human rights violation and social disparities Feminist ethic, surrogacy/pregnancy. Ethics of media- Impact of Newspapers, Television Movies and Internet.

Suggested Readings:

1. John S Mackenjie: A Manual of ethics.
2. "The Ethics of Management": by Larue Tone Hosmer, Richard D. IrwinInc.
3. "Management Ethics – integrity at work" by Joseph A. Petrick and JohnF. Quinn, Response Books: New Delhi.
4. "Ethics in Management" by S.A. Sherlekar, Himalaya Publishing House.
5. Harold H. Titus: Ethics for Today.
6. Maitra, S.K: Hindu Ethics.
7. William Lilly: Introduction to Ethics.
8. Sinha: a Manual of Ethics.
9. Manu: Manu Dharma Sastra or the institute of Manu: Comprising the Indian system of Duties: Religious and Civil(ed) G.C. Haughton.
10. Susruta Samhita: Tr. Kaviraj Kunjanal, Kunjanal Brishagratha, Chowkamba Sanskrit Series. Vol. I,II,III, Varanasi VOL. I OO, 16-20, 21-32, and 74-77 only.
11. Caraka Samita: Tr. Dr. Ram Karan Sharma and Vaidya Bhagavan Dash, Chowkamba Sanskrit Series Office, Varanasi. I,II,III VOL. I, PP 183-191.
12. Ethics, Theory and Contemporary issues, Barbara Mackinnon, Wads Worth/Thomson Learning 2001.
13. Analyzing Moral issues, Judith A. Boss, Mayfield Publishing Company ,1999.
14. An Introduction to Applied Ethics (Ed.) John H. piet and Ayodhya Prasad, Cosmo Publications.
15. Text book for Intermediate logic, Ethics and Human Values, Board of Intermediate Education & Telugu Academic Hyderabad.
16. I.C Sharma Ethical Philosophy of India. Nagin& Co. Julundhar.

SEMESTER – III
CORE THEORY-1
GEG 301: URBAN GEOGRAPHY

Learning objectives:

- To deal with the concept of urban settlements and evolution of urban population and to provide concept of Urban studies.
- To explain the cause and effects of growth in urban population.
- To explain the theories involved in classifications of towns and relationship between townsand cities and their population.
- To understand patterns of World urbanization with reference to India

Learning out comes:

After the completion of the course, Students will be able to

- Learn the concept of urban settlements and evolution of urban population and to provide concept of Urban studies.
- Understand the cause and effects of growth in urban population
- Explains the theories involved in classifications of towns and relationship between towns and cities and their population.
- Distinguish patterns of Worldurbanization with reference to India**.**

P.T.O

SYLLABUS

UNIT I Urban Geography : Definition, Nature and scope. Urban growth, structure and slums. Urban settlements - Impact of the Industrial revolution on location, spacing and size of urban settlements

UNIT II Origin and evolution of cities: Ancient, Medieval and Modern cities. Primate city, Metropolis; Megalopolis and Conurbation, The concept of Smart Cities and Satellite towns, Patterns of towns and city's.

;.

UNIT III Urban Hierarchy, Rank– size relationship, Nearest Neighbor analysis– classification of towns with special reference to functional classification. Urban Morphology - Theory's: Concentric Zone, Multiple-nuclei, Central Place and Sector Theory.

UNIT IV Rural – urban relationships, rural - urban fringe, urban decay, urban sprawl urban renewal. The concept of city – region: Urban Um-land and hinter land; Pattern of world urbanization with special reference to India and Andhra Pradesh.

Suggested Readings

1. Johnson, J.H., Urban Geography. An Introductory Analysis, Pergaman Press, Oxford, 1967.
2. Murphy, R. : The American City : an Urban Geography McGraw Hill, 1966.
3. Dickinson, R.E. : City and Region, Routledge and Kegen, Paul Ltd., London, 1964
4. Mayer and Cohen : Readings in Urban Geography, Central Book Depot., Allahabad.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	1	3	3	1	2	1	3	3	3	1
CO_2	3	3	1	3	3	3	3	1	3	3	3	3
CO_3	3	3	1	3	3	3	2	1	3	3	3	2
CO_4	3	3	1	3	1	3	3	1	3	3	3	1

CORE THEORY-2

GEG 302: GEOGRAPHICAL INFORMATION SYSTEM (GIS)

Learning objectives:

- To understand the evolution of GIS.
- To focus on collection, analyzing, interpretation andresenting the data related to Earth.
- To explains the types of data collection with respective to time and terrain and Data base management and retrieving the data from different sources.
- To provides the theoretical knowledge on the Modeling surfaces and integration of Remote sensing with GIS.
- To provide knowledge on GIS applications in different sectors.

Learning Outcomes:

After the completion of the course, Students will be able to

- Understand the evolution of GIS**.**
- focus on collection, analyzing, interpretation andresenting the data related to Earth.
- Differentiate the types of data collection with respective to time and terrain and Data base management and retrieving the data from different sources**.**
- Improve knowledge on the Modeling surfaces and integration of Remote sensing with GIS.
- Develops knowledge on GIS applications in different sectors.

P.T.O

SYLLABUS

UNIT I GIS: Definitions and Development – Computer Components of GIS (Hardware and Software) – General Data Base concepts of Spatial and Non - spatial data - Elements of Spatial data - Sources of Spatial data – Data quality for GIS – Errors and Error variations in GIS.

UNIT II GIS Data Management: Data Base Management Systems (DBMS) Data BaseModels. Data input methods – Spatial Data structures: Raster data and Vector data – Structures – GIS Data Analysis: Spatial measurementmethods Reclassification – Buffering – Overlay Analysis.

UNIT III Modeling Surfaces: Co- or di na tes, Generation of DEM, DTM and TIN models – Spatial Interpolation – GIS output generation – Integration of Remote Sensing and GIS. Network Analysis.

UNIT IV GIS applications: GIS as a Decision Support System – GIS as a Land Information System – GIS as a Disaster Management and Emergency Response System - Resource management applications - Facility Management application – Urban Management application.

Suggested Readings

1. Aronoff S. Geographic Information System : A Management Perspective, DDLPublication, Ottawa. 1989.
2. Burrough P.A. Principles of Geographic Information Systems for Land ResourceAssessment. Oxford University Press, New York, 1986.
3. Fraser Taylor D.R. Geographic Information System. Pergamon Press, Oxford, 1991.
4. Maquire D. J.M.F. Goodchild and D.W. Rhind (eds.) Geographic InformationSystems : Principles and Application. Taylor & Francis, Washington, 1991.
5. Mark S. Monmonier. Computer – assisted Cartography. Prentice – Hall, EnglewoodCliff, New Jersey, 1982.
6. Peuquet D.J. and D.F. Marble, Introductory Reading in Geographic InformationSystems. Taylor & Francis, Washington, 1990.
7. Star J. and J. Estes. Geographic Information Systems : An Introduction. PrenticeHall, Englewood, Cliff, New Jersey, 1994.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2	2	1	1	2	2	2	2	2	2	2
CO_2	2	3	2	1	1	2	2	2	2	2	2	2
CO_3	2	2	2	3	2	3	2	2	2	2	2	2
CO_4	1	3	2	1	2	3	2	2	2	2	2	2
CO_5	2	2	3	2	2	3	2	3	2	2	2	2

GENERIC ELECTIVE (Opt-1)

GEG-303(A): AGRICULTURAL GEOGRAPHY

Learning objectives:

- To focus on evolution of Agriculture through at the different ages and approaches.
- To understand the concepts and importance of determinants in different cropping patterns.
- To understand agricultural location theories also the problem and prospects of Indian Agriculture .

Learning Outcomes:

After the completion of the course, Students will be able to

- Know evolution of Agriculture through at the different ages and approaches.
- Understand the concepts and importance of determinants in different cropping patterns.
- Differentiate the Determinants of Agriculture
- Understand agricultural location theories also the problem and prospects of Indian Agriculture .

SYLLABUS

UNIT I Nature, Scope, significance and development of Agricultural Geography. Approaches to the study of agricultural geography; Origin and evolution ofagriculture.

UNIT II Determinants of agriculture – Physical, Socio -economic, technological andpolitical; concepts and methods of land use classification.

UNIT III Concepts and methods of Agriculture: Crop combination; Crop concentration; Crop diversification; agricultural productivity; agricultural typology.

UNIT IV Agricultural location theory – Von Thunen and its modifications. Concepts of agricultural region and agricultural regionalization. Whittlesey's agricultural systems of the world. Agricultural regions of India. Green revolution, HYV; Problems and prospects of Indian agriculture.

Suggested Readings

1. Bayliss Smith,T.P.: The Ecology of Agricultural Systems. Cambridge University Press, London, 1987.
2. Berry, B.J.L. et al. : The Geography of Economic Systems. Prentice Hall, NewYork, 1976.
3. Dyson, T. : Population and Food – Global Trends and Furure Prospects. Routledge,London, 1996.
4. Gregor, H.P. : Geography of Agriculture. Prentice Hall, New York, 1970.
5. Grigg, D.B. : The Agricultural Systems of the World. Cambridge University Press,New York, 1974.
6. Hartshorn, T.N. and Alexander, J.W. : Economic Geography. Prentice Hall, NewDelhi, 1988.
7. Morgan, W.B. and Norton, R.J.C. : Agricultural Geography. Mathuen, London,1971.
8. Singh, J. and Dhillon, S.S. : Agricultural Geography, Tata McGraw Hill Pub., NewDelhi, 1988.
9. Tarrant, J.R : Agricultural Geography. Wiley, New York, 1974

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2	2	1	1	2	2	3	2	2	2	2
CO_2	2	2	2	1	1	2	2	3	2	2	2	2
CO_3	2	2	2	1	1	2	2	3	2	2	2	2
CO_4	2	2	2	1	1	2	2	3	2	2	2	2
CO_5	2	2	2	1	1	2	2	3	2	2	2	2

GEG-303(B) TRANSPORT GEOGRAPHY

Learning objectives:

- To focus on evolution and development of transport through at the different ages and approaches.
- To understand the concepts and importance of determinants of transport patterns.
- To understand transport theories also the problem and prospects of Indian transport .

Learning Outcomes:

After the completion of the course, Students will be able to

- Know evolution and development of Transport through at the different ages and approaches.
- Understand the concepts and importance of determinants in different transport patterns.
- Differentiate the Determinants of transport and trade.
- Understand transport theories also the problem and prospects of Indian transport. .

P.T.O

SYLLABUS

UNIT I Nature, scope, significance and development of transport geography. Factors for development of transport system; economic, social, cultural and institutional. Different types of Transportation-their merits and demerits Factors controlling the cost of transport.

UNIT II Transport: Structure, accessibility and flow models; network structure, graph theoretic measures, measurement of accessibility, models of network change, linear programming and gravity models.

UNIT III Theories related to freight route structure. Bases of spatial interaction, Complementarily, intervening opportunities and transferability. Patterns of movement

UNIT IV Transport policy and planning in India. Urban transport: growth and problem of urban transportation. Environmental degradation: vehicular pollution and congestion alternatives to the transport system in mega cities.

Suggest Readings:

1. Chorley R.J. &Hagett P.: Models in Geography Methuen & Co. London. 1967.
2. Hurst, M.E.(ed.): Transportation Geography, McGraw-Hill, 1974.
3. Hagget, F and Chorlley, R.J. Network Analysis', Edward Arnold, London, 1968.
4. Hay, A.: Transport Economy, MacMillan, London, 1973.
5. Hoyle, B.S.(ed): Transport and Development, MacMillan, London, 1973.
6. Raza, M. and AgrawalY.P. :Transport Geography of India, Concept, New Delhi, 1985.
7. Robison H &Bamford C.G.: Geography of Transport Machdonals& Evans. London 1978.
8. Taffe, E.J. & Gauthier (Jr.) H.L. Geography of Transportation, Prentice-Hall, Englewood Cliffs, N.J., 1973.
9. Ullman E.L.: American Commodity Flow University of Washington Press 1957.
10. White H.P. and Senior, M.L. Transport Geography, Longman, London, 1983.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	2	2	2	2	2	2	3	2	2	2	2
CO_2	3	2	2	2	2	2	1	2	2	2	2	2
CO_3	3	2	2	2	1	2	3	2	2	2	2	2
CO_4	3	2	2	2	1	2	3	2	2	2	2	2
CO_5	2	2	2	1	1	2	3	2	2	2	2	2

GEG-303(C) DISASTER MANAGEMENT STUDIES

Learning objectives:

- To develop the skill of understanding about natural calamities and disaster and also realize the consequences as well as preparedness.
- To create awareness on human and natural disasters
- To understand classification of disasters and its impacts

Learning Outcomes:

After the completion of the course, Students will be able to

- Develop the skill of understanding about natural calamities and disaster and also realize the consequences as well as preparedness.
- Improve awareness on human and natural disasters
- Understand classification of disasters and its impacts and management of disasters

SYLLABUS

UNIT I: Disaster: Meaning and Concept, types of Disasters. Natural disasters: Earthquakes Hazardous effects, Volcanic eruptions – Hazardous effects.Certain case studies.

UNIT II: Cyclones and floods : cyclone related parameters and effects on land and sea-damage assessment. Causes of flood and food prone area analysis –damage assessment. Certain case studies.

UNIT III (a) Droughts and desertification: Types of droughts – factors influencing droughts – land use and groundwater level changes – delimiting drought prone areas.

(b)Main induced disasters: Deforestation and environmental degradation,urbanization, industrial development and environmental pollution. Types of pollution : air pollution, water pollution, soil pollution and noise pollution.

UNIT IV Disaster management: Pre and post disaster operations of Earthquakes, cyclones, floods, droughts, forest fires. The role of Remote Sensing and GIS in disaster management studies.

Suggested Readings

1. Savindra Singh, Environmental Geography, Prayag Pintak Bhavan, Allahabad,2006.
2. Singh, L.R., Singh, Savindra, Tiwari, R.C. and Srivastava, R.P.: EnvironmentalManagement (edited), Allahabad University, 1983.
3. Singh, Savindra : Flood hazards and environmental degradation; A case study ofthe Gomathi River, in environmental management, Allahabad University, 1983.
4. John, A. Mattlews : Natural hazards and environmental change. Bill Mcguire, Ian Mason, 2002.
5. Nimpuno, K : Disasters and Social Response, ITC, 1989.
6. Hooja, R. and Joshi, R. : Desert, Drought and Development Studies in ResourceManagement and Substainability: Rawat Publications, Jaipur, 1994.
7. Aronaff, S : Geographic Information Systems; A Management Perspective, DDLPublications, Ottawa, 1989.
8. Barrett, E.C. and Curtis, L.F.: Fundamentals of Remote Sensing and Air photointerpretation, Mcmillan, New York, 1992.
9. Bring, N., Dhal and Ms. Sunita Dhal : Can GIS and Disaster Management Systemhelp, GIS India? Vol.9, No.1, January -February, 2000.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2	1	3	2	2	3	3	2	2	2	2
CO_2	3	2	3	1	1	3	2	3	2	2	2	2
CO_3	3	2	2	2	3	2	2	3	2	2	2	2
CO_4	3	2	2	2	3	3	2	3	2	2	2	2
CO_5	2	2	3	1	1	2	2	3	2	2	2	2

PRACTICAL

GEG-304: GEOGRAPHICAL INFORMATION SYSTEM(GIS)

Learning objectives:

- To acquaint knowledge the about especially Geographic Information System (GIS) softwares.
- .To develop the skill of geo-referencing and creation of different data files.
- To improve the practical knowledge on attribute data and linkage.
- To develop the skill on analysis methods of GIS.

Learning Outcomes:

After the completion of the course, Students will be able to

- Acquaint knowledge the about especially Geographic Information System (GIS)softwares.
- . Develop the skill of geo-referencing and creation of different data files.
- Improve the practical knowledge on attribute data and linkage.
- Develop the skill on analysis methods of GIS.

SYLLABUS

UNIT I GIS Capabilities

UNIT II Introduction to ARC GIS Software

(a) Arc Map, (b)Arc Catalogue.(c) Arc Tool box, (d)Table of Contents,(e)Arc Scan

UNIT III Geo-Referencing.

UNIT IV Creation of File Geo data base, Personal Geo -data base, shape file. – Data Base generation – Spatial data generation – Digitization (Polygon, line and point) and Non -spatial data.

UNIT –V Attribute data base and linkage of data Base.

UNIT VI GIS-Analysis Methods

(a) Buffering, (b) Map overlay,(c) Interpolation, (d) Contours,(e), Slope, (f) DEM

Suggested Readings

1. Ian Heywood et al. An Introduction to Geographical Information Systems,Addison Wesley Longman Ltd. 1998.
2. Mishra, H.C.; GIS Handbook, GIS India, Hyderabad, 1996.
3. Peter A. Burrough and Rachael A. McDonnell; Principles of GeographicalInformation Systems; Oxford University Press, New York, 1998.
4. Star J and J. Estes; Geographic Information Systems; An Introduction, PrenticeHall, Englewood Cliff, New Jersey, 1994.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	2	2	2	2	3	2	2	2	2	2	1
CO_2	3	1	2	2	2	3	2	2	2	2	3	2
CO_3	3	1	2	2	2	3	2	2	2	2	3	3
CO_4	3	1	2	2	2	3	2	3	2	2	2	2
CO_5	2	1	2	2	1	2	2	3	2	2	2	2

SKILL ORIENTED COURSE

(MANDATORY THEORY & PRACTICAL)

GEG-305: GLOBAL POSITIONING SYSTEM (GPS) DIGITAL SURVEY AND REPORT

Learning objectives:

- To develop the skill of understanding GPS and Survey.
- To create awareness on post processing of GPS data and collection of data from GPS survey.
- To develop skill of report writing by using GPS data and software and hardware.

Learning Outcomes:

After the completion of the course, Students will be able to

- Develop the skill of understanding GPS and Survey.
- Generate awareness on post processing of GPS data and collection of data from GPS survey.
- Develop skill of report writing by using GPS data and software and hardware.

SYLLABUS

(THEORY)

UNIT-I Global Positioning System (GPS) - Basic concept, system architecture, space segment, user segment; GPS Signals:- Signal structure, selective availability; GPS coordinate frames Time references: Geodetic and Geo centric coordinate systems, world geodetic 1984 (WGS 84), GPS time.

UNIT-II GPS Applications - Field Data collection, Navigation, Aviation, Marine, Rail, Roads and highways, Space, Survey mapping, Defense, Agriculture, Environment.

(PRACTICAL)

UNIT III Introduction to GPS systems: Hardware, Software. Field procedures of GPS.

UNIT IV GPS surveying. Data collection procedures: Point, Line and Area data collection. Post processing of the GPS data. GPS and GIS integrations output preparation. Report.

Suggested Readings:

1. Bailey, T. and Gatrell, A. C. (1995): Interactive Spatial Data Analysis. Longman ,Harlow.
2. Dorling, D. and Fairborn, D. (1997): Mapping. Ways of Representing the World. Longman, Harlow.
3. Fraser Taylor, D.R. (1980): The Computer in Contemporary Cartography. John Wiley and Sons, New York.
4. Fraser Taylor, D.R. (ed.) (1983): Graphic Communication and Design in Contemporary Cartography. John Wiley and Sons, New York.
5. Kanetkar, T.P. and Kulkarni, S.V. (1967): Surveying and Levelling, Part II, A.V.G. Prakashan, Poona.
6. Keates, J.S. (1973): Cartographic Design and Production, Longman Group Ltd.
7. Mailing, D.H. (1973): Co-ordinate Systems and Map Projections. George Philip and Sons Ltd.
8. Rhind, B. and Adams, T. (ed.) (1983): Computers in Cartography. British Cartographic Society, London.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2	2	1	1	2	2	3	2	2	2	2
CO_2	2	2	2	1	1	2	2	3	2	2	2	2
CO_3	2	2	2	1	1	2	2	3	2	2	2	2
CO_4	2	2	2	1	1	2	2	3	2	2	2	2
CO_5	2	2	2	1	1	2	2	3	2	2	2	2

OPEN ELECTIVE (OPT - 1)

GEG 306(A): REGIONAL GEOGRAPHY OF ANDHRA PRADESH

Learning objectives:

- To develop the understanding about physical features of Andhra Pradesh..
- To familiarize the students with physiography, Drainage, Climate, soil and natural vegetation of Andhra Pradesh.
- To visualise the population, mineral and transportation structures in Andhra Pradesh

Learning Outcomes:

After the completion of the course, Students will be able to

- Develop the understanding about physical features of Andhra Pradesh..
- Familiarize the students with physiography, Drainage, Climate, soil and natural vegetation of Andhra Pradesh.
- Visualise the population, mineral and transportation structures in Andhra Pradesh

SYLLABUS

UNIT I: Re-organization of Andhra Pradesh Act -2014 Location and physical setting – Major Physiographic Divisions– Soils, Vegetation, and Drainage – Climate Regions and their Characteristics.

UNIT II Population Distribution; Density, growth and problems. Agriculture Types. Irrigation and power; Multipurpose Projects, Major food grain crops.(Paddy, Jower and Ragi), major Commercial Crops (Cotton, Groundnut and Mango).

UNIT III Mineral Resources: Iron ore, Limestone and Petroleum, Industries: Iron and Steel, Cotton and IT. Industrial Regions and Special Economic Zones (SEZ) Andhra Pradesh.

UNIT IV Transportation and Communication – Road, Rail, Water (special reference to coastal Transport) and Air Transport. Communication net work in Andhra Pradesh

Suggested Readings:

1. Take from 401, 4, 5 from old syllabus.
2. Structure, growth an d prospects of Industries in Andhra Pradesh. lotuspublications, Varanasi - 1989.
3. Regional Geography of Andhra Pradesh – Telugu Academy.
4. Andhra Pradesh year book -2010-2015

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	3	1	3	3	3	3
CO_2	3	3	3	3	3	3	3	1	3	3	3	3
CO_3	3	3	3	3	3	3	3	1	3	3	3	3
CO_4	3	3	3	3	3	3	3	1	3	3	3	3

GEG306 (B): GEOGRAPHICAL INFORMATION SYSTEM

(GIS) & GLOBAL POSITIONINGSYSTEM (GPS) AND APPLICATIONS

Learning objectives:

- To understand the evolution of GIS and GPS.
- To focus on collection, analyzing, interpretation andresenting the data related to Earth.
- To explains the types of data classification in GIS.
- To provides the theoretical knowledge on the Modeling surfaces and integration of Remote sensing with GIS.
- To provide knowledge on GIS and GPS applications in different sectors.

Learning Outcomes:

After the completion of the course, Students will be able to

- Understand the evolution of GIS**.**
- Focus on collection, analyzing, interpretation andresenting the data related to Earth.
- Differentiate the types of data
- Improve knowledge on the Modeling surfaces and integration of Remote GPS with GIS.
- Develop knowledge on GIS and GPS applications in different sectors.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	2	1	2	2	3	3
CO_2	3	3	3	3	3	3	2	1	2	2	3	3
CO_3	3	3	3	3	3	3	2	1	2	2	3	3
CO_4	3	3	3	3	3	3	2	1	2	2	3	3

P.T.O

SYLLABUS

UNIT I: GIS - Definition, History, Development and components. GIS Data Generation :- Spatial and Non Spatial Data; Data structures : Raster and Vector; Geo-coordinate system; Data analysis: Measurement & Connectivity, Interpolation , Classification. TIN, DTM ,DEM Modals.

UNIT II: GIS Applications - GIS as a decision support system, management of information system, land information system, Urban planning management, Disaster management and Emergency Response System, Resource management applications, Network applications, facility management applications.

UNIT-III Overview of GPS - Basic concept, system architecture, space segment, user segment; GPS Signals:- Signal structure, Anti Spoofing (AS), selective availability; GPS coordinate frames Time references: Geodetic and Geo centric coordinate systems, world geodetic 1984 (WGS 84), GPS time.

UNIT-IV GPS Applications - Field Data collection, Navigation, Aviation, Marine, Rail, Roads and highways, Space, Survey mapping, Defense, Agriculture, Environment.

Suggested Readings:

1. Burrough, P.A., 1986, Geographical Information System for land Resources System, OxfordUniv. Press, UK.
2. Fotheringham, S.; Rogerson, P. (ed.), 1994. Spatial analysis and GIS. Taylor and Francis,London, UK.
3. Laurini, Robert and Dierk Thompson, 1992, Fundamentals of Spatial Information Systems, Academics Press, ISBN 0-12-438380-7.
4. Maguire,D.J.; Goodchild, M.F.; Rhind,D.W. 1991.Geographical information System,Longman, London,UK
5. Siddiqui, M.A.; 2006, Introduction to Geographical Information System, Sharda PustakBhavan,
6. Allahabad. Siddiqui, M.A.; 2011, Concepts and Techniques of Geoinformatics, Sharda Pustak Bhavan,Allahabad.
7. G S RAO, Global Navigation Satellite Systems, McGraw-Hill publications, New Delhi, 2010
8. B. Hoffman – Wellenhof, H. Liehtenegger and J. Collins, 'GPS – Theory and Practice',Springer – Wien, New York (2001).
9. James Ba – Yen Tsui, 'Fundamentals of GPS receivers – A software approach', John Wiley& Sons (2001).
10. Bradford W. Parkinson,James J. Spiker Jr, 1996. Global Positioning System: Theory andApplications, Vol I and II, American Institute of Aeronautics and Astronautics: Washin.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	2	1	2	2	3	3
CO_2	3	3	3	3	3	3	2	1	2	2	3	3
CO_3	3	3	3	3	3	3	2	1	2	2	3	3
CO_4	3	3	3	3	3	3	2	1	2	2	3	3

SEMESTER – IV

CORE THEORY-1

GEG 401: REGIONAL PLANNING

Learning objectives:

- To apprise the concept of Region and its planning.
- To explains the types of regions and regional hierarchy.
- To explains the types of regional planning and planning process.
- To the people participation in planning process and role of Panchayat Raj system
- To explain the resource based and physiographic based regional planning.

Learning Outcomes:

After the completion of the course, Students will be able to

- Acquire a solid base of knowledge in the principles and practices Regional planning.
- The skills necessary for the effective practice of planning, including its purpose, meaning elements of plans; adoption, administration, and implementation of plans.
- Develop the values necessary for the effective practice of planning, including problem-solving skills; research skills; written, graphical, and oral skills; computational skills.
- Learn the values and ethical standards affecting the practice of planning.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	2	1	2	2	3	3
CO_2	3	3	3	3	3	3	2	1	2	2	3	3
CO_3	3	3	3	3	3	3	2	1	2	2	3	3
CO_4	3	3	3	3	3	3	2	1	2	2	3	3

P.T.O

SYLLABUS

UNIT I Regional Planning: Definition, Nature and scope. Concept of Region; Changing concept of the region from an inter -disciplinary view – point; concepts of regionalism and regionalization. Types of Regions: Formal and functional, uniform and Nodal, single purpose and composite regions, regional hierarchy and special purpose regions.

UNIT II Types of Planning- Sectoral, Temporal; short term, long term and Multilevel planning and planning process. Government planning polices.

UNIT III Decentralized Planning: Peoples participation in the Planning process; Panchayathi Raj system. Theories of development- Spatial and Non spatial.

UNIT IV Physical resource and special purpose regions: River valley regions, hilly and tribal regions, drought prone regions, Special Economic Zones and metropolitan regions.

Suggested Readings

1. Sundaram, K.V. : Urban and Regional Planning, Vikas Publishing house, NewDelhi, 1977.
2. Misra, R.P. and Sundaram, K.V. : Rural Area Development, Sterling Publishers,New Delhi, 1979.
3. Misra, R.P., Urs, D.V. and Nataraj, V.K. : Re gional Planning and NationalDevelopment, Vikas Publishers, New Delhi, 1978.
4. Misra, R.P. : Regional Planning Concepts, Techniques and case studies,Prasaranga Press, University of Mysore, Mysore, 1969.
5. Sengupta, P. and Galina Sdasyuk : Economic Regionalisa tion of India: Problemsand Approaches, Census of India, Monogram, New Delhi, 1968.
6. Planning Dept. Government of Andhra Pradesh : Planning and Development ofBackward Regions – A Case Study of Rayalaseema.
7. Mishra, R.P. et al. Multi-Level Planning : Heritag e Publishers, Delhi, 1980.
8. Bhat, L.S. et al. Micro-Level Planning : A Case Study of Kamal Area, Haryana, K.BPublications, New Delhi, 1976.
9. Friedmann, J. and Alonso, W. : Regional Development and Planning – A Reader, M.I.T. Press, Cambridge Mass, 1967.
10. Kuklinski, A.R. (ed.) : Growth Poles and Growth Centres in Regional Planning,Mouton, The Hague, 1972.

CORE THEORY-2

GEG 402: ADVANCED REMOTE SENSING

Learning objectives:

- To give broad knowledge on photogrammetry, Principle, process, platforms and techniques and Aerial photographs.
- To provide knowledge on software and hardware required for digital image processing, image enhancement and restoration techniques.
- To understand the application of remote Sensing and Photogrammetry in various fields of study.

Learning Outcomes:

After the completion of the course, Students will be able to

- Demonstrate knowledge of the foundations and theories of Photogrammetry, aerial photography and remote sensing.
- Acquire knowledge of physical geography and the methods and techniques for observing, measuring, recording and reporting on geographic phenomena.
- Demonstrate their competence to work individually and as a team to develop and present a client-driven GIS solution.
- Prepared to apply their skills in professional careers.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	2	1	2	2	3	3
CO_2	3	3	3	3	3	3	2	1	2	2	3	3
CO_3	3	3	3	3	3	3	2	1	2	2	3	3
CO_4	3	3	3	3	3	3	2	1	2	2	3	3

P.T.O

SYLLABUS

UNIT I Photogrammetry : Introduction; Geometric elements of vertical photographs; scales of Aerial photographs; scale distortions; Flight planning; Relief displacement; parallax measurement; Orthophotography and rectification – principles and procedures.

UNIT II Digital Image Processing: Introduction to digital image processing; Image processing system characteristics: Hardware and Software; Image restoration Techniques: Restoring line dropouts, Restoring periodic line striping, Restoring line offsets, Filtering random noise; Radiometric corrections and Geometric corrections in image processing.

UNIT III Image Enhancement Techniques: Contrast enhancement, Density slicing, Edge enhancement, Merging data sets, Synthetic stereo images; Digital mosaics. Information extraction techniques: Principal – component (P.C) transformation analysis, Ratio images, Multispectral classification, Change -detection images.

UNIT IV Remote Sensing Applications to Geographical Studies: Land use/Land cover mapping; water resources; Geomorphological, waste land studies, Urban and Regional Planning.

Suggested Readings:

1. American Society of Photogrammetry : Manual of Remote Sensing, ASP, FallsChurch, V.A. 1983.
2. Barrett, E.C and L.F. Curtis : Fundamentals of Remote Sensing and Air PhotoInterpretation, Mcmillan, New York, 1992.
3. Compbell, J. : Introduction to Remote Sensing, Guilford, N ew York, 1989.
4. Curran, Paul, J. : Principles of Remote Sensing, Longman, London, 1985.
5. Hord, R.M. : Digital Image Processing of Remotely Sensed Data; Academic NewYork, 1989.
6. Luder D. : Aerial photography Interpretation : Principles and Applications, Mc Graw Hill, New York, 1959.
7. Pratt, W.K Digital Image Processing, Wiley, New York, 1978.
8. Rao, D.P. (Eds) : Remote Sensing for Earth Resources, Associate of Exploration Geophysicist, Hyderabad, 1998.
9. Thomas, M. Lillesand and Ralph W. Kefer : Remote Sensing and Image Interpretation, John Willey & Sons, New York, 1994.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	3	1	2	2	3	3
CO_2	3	3	3	3	3	3	3	1	2	2	3	3
CO_3	3	3	3	3	3	3	3	1	2	2	3	3
CO_4	3	3	3	3	3	3	3	1	2	2	3	3

GENERIC ELECTIVE (Opt-1)

GEG-403(A): WATER AND SOIL RESOURCES MANAGEMENT

Learning objectives:

- To apprise the students to various water resources related aspects and hydrological cycle.
- To focus on ground water and soil specifications.
- To develop skill of water and soil management and to study on some case studies .

Learning Outcomes:

After the completion of the course, Students will be able to

- Apprise the students to various water resources related aspects and hydrological cycle.
- Focus on ground water and soil specifications.
- Develop skill of water and soil management and to study on some case studies.

SYLLABUS

UNIT I Water as a focus of geographical interest, Inventory and distribution of world's water resources (Surface and Subsurface); World Hydrological cycle- precipitation and its Measurement, water balance studies.

UNIT II Groundwater: Origin, Occurrence and Vertical distribution; water quality: Physical, biological and chemical properties for irrigation, domestic and industrial purposes.

UNIT III Water Resources Management: conjunctive use of surface and ground water resources; watershed management. Methods of irrigation. Water harvestingtechniques: Formation of new Check dams, tanks, Perculation tanks/Pits and Counter trenches etc.

UNIT IV Soils: Process of soil formation and soil development. Soil profiledevelopment. Properties of soil – Physical, morphology, texture, structure and chemical properties. Soil erosion – degradation and conservation. Management of saline and alkaline soils.

Suggested Readings

1. Dakshinamur thy, C. et al., Water Resources of India and their utilization in Agriculture, Indian Agriculture Research Institute, New Delhi, 1973.
2. Bunting, B.T. : The Geography of Soils; Hutchinson, London, 1973.
3. Foth, H.D and Turk, L.M. : Fundamentals of Soil Science s, John Wiley, New York,1972.
4. Jones, J .A. : Global Hydrology : Processes, Resources and Environmental Management, London, 1997.
5. Matter, J.R. Water Resources Distribution, Use and Management, John Wiley,Marylane, 1984.
6. Singh, R.A and Singh, S.R. Water Man agement. Principles and Practices, Tara Publication, Varanasi, 1979.
7. Tideman, E.M. Watershed Management : Guidelines for Indian Conditions, Omega, New Delhi, 1996.
8. Todd, D.K.: Ground Water Hydrology, John Wiley, New York, 1959.
9. Sarma, Hydrdogy, Dhanpat Roy & Sons, New Delhi.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	3	1	3	2	3	3
CO_2	3	3	3	3	3	3	3	1	3	2	3	3
CO_3	3	3	3	3	3	3	3	1	3	2	3	3
CO_4	3	3	3	3	3	3	3	1	3	2	3	3

GENERIC ELECTIVE (Opt-1)

GEG-403(B): POLITICAL GEOGRAPHY

Learning objectives:

- To explain the historical evolution, of discipline of Political Geography..
- To help to understand about theoretical models related to geopolitics and geo- strategy.
- To provide the knowledge about political attributes that evolved with territorial structure and geographic influence like state, nation, boundary, elections, and frontier of world in general and India in particular.

Learning Outcomes:

After the completion of the course, Students will be able to

- Apprise the Students will be able to critically examine the geographical bases of political studies.
- Able to evaluate and correlate different theories with contemporary geopolitical and geo-strategic issues.

P.T.O

SYLLABUS

UNIT I Definition, Nature and scope of political geography. Influence of location, size and shape in political Geography.

UNIT-II Geographic elements and the state: influence of physical, Human and Economic elements. Geo-strategic Theories: Mahan, Mackinder and Spykman.

UNIT-III Themes in Political geography : State, Nation, Land locked state, and Nation Building :Formation of Frontiers and boundaries, classification of boundaries. colonialism, De colonialism, Neo colonialism, federalism and other forms of Governance.

UNIT-IV Geopolitical significance of India and the Indian Ocean, maritime boundaries. The Changing political map of India, unity in diversity, centripetal and centrifugal forces, stability and instability. International disputes.

Suggested readings:

1. Prescott, J.R.V: Political Geography, Methuen, London, 1972.
2. Gohen,S.B:Geogrphy of Political in a devide world , Open university press,U.K.1973.
3. Sukhwal,B.L. : India -A Political Geography, Ahmadabad, 1971.
4. Gohen,S.B. Background to political geography, Museum Press, London, 1967.
5. Maszid Hussain: Political Geography of India, New Delhi.
6. De Blij, H.J. and Glassner, Martin: Systematic Political Geography, Johyn Wiley, New York, 1968.
7. Dikshit, R.D. :Political Geography A contemporary perspective, Tata McGraw Hill, New Delhi, 1996.
8. Dikshit, R.D. : Political geography: A century of6 7. 8. progress, Sage, New Delhi, 1999.
9. Taylor, Peter. Political Geography, Longman, London, 1985.
10. Deshpande, C.D. India -A Regional Interpretation Northern Book Centre, New Delhi, 1992.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	2	1	3	2	2	3
CO_2	3	3	3	3	3	3	2	1	3	2	2	3
CO_3	3	3	3	3	3	3	2	1	3	2	2	3
CO_4	3	3	3	3	3	3	2	1	3	2	2	3

GENERIC ELECTIVE (Opt-1)

GEG-403(C): RESEARCH IN GEOGRAPHICAL STUDIES

Learning objectives:

- To explain the historical evolution, of research in Geographical studies.
- To help to understand about ethics, methods and factors in geographical research.
- To provide the knowledge about forms of research and design.
- To illustrate research methods and data collection.
- To acquaint research analysis and report writing.

Learning Outcomes:

After the completion of the course, Students will be able to

- Explain the historical evolution, of research in Geographical studies..
- Understand about ethics, methods and factors in geographical research.
- Improve the knowledge about forms of research and design.
- Illustrate research methods and data collection.
- Acquaint research analysis and report writing.

P.T.O

SYLLABUS

UNIT I Research: Meaning, definitions, objectives, characteristics, types, Research ethics approaches, significance, research and scientific methods, criteria of research, Recent trends in Geographical Studies: physical and human geography. Review of literature, review of literature.

UNIT II Forms of Research: Research problems: selecting the research Problem, defining the problem. Research paper, Article, Workshop, Seminars, Conference and Symposia. Research design: Meaning, need important concepts and development relating to research design.

UNIT III Research methodology: Data collection and methods. Sampling methods: Random Sampling, stratified sampling. Collection of Primary data: Observation method, interview method, Case study method, questionnaire and secondary data.

UNIT IV Hypothesis: Basic concepts concerning testing of hypothesis. limitations of the tests of hypothesis. Interpretation procedure. Report writing - significance of report writing, different steps in report writing, layout of the research report, types of reports, conclusion, findings and suggestions. Bibliography, appendices, Plagiarism.

Suggested Readings:

1. Gilbert, N. 2001: Researching Social Life, Sage, London.
2. Flowerdew, R. and D. Martin 2005: Methods in Human Geography: A Guide for students doing a research project, Prentice Hall, New York.
3. Clifford, N.J. and G. Valentine 2003: Key methods in Geography, Sage, London.
4. Leedy, P. D. and J.E. Ormrod 2001: Practical Research: Planning and Design.

Web resources:

http://www.acm.org intute.ac.uk/socialsciences/

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	2	1	3	2	3	3
CO_2	3	3	3	3	3	3	2	1	3	2	3	3
CO_3	3	3	3	3	3	3	2	1	3	2	3	3
CO_4	3	3	3	3	3	3	2	1	3	2	3	3

PRACTICAL

GEG 404: REMOTE SENSING APPLICATIONS

Learning objectives:

- To explain practical knowledge on Remote sensing applications...
- To help to understand Visual and digital interpretation of satellite Images.
- To illustrate interpretation of Aerial photos.
- To acquaint knowledge on allocation of RS in different fields and sectors.

Learning Outcomes:

After the completion of the course, Students will be able to

- Explain practical knowledge on Remote sensing applications...
- Understand Visual and digital interpretation of satellite Images.
- Illustrate interpretation of Aerial photos.
- Acquaint knowledge on allocation of RS in different fields and sectors.

SYLLABUS

UNIT I Techniques of Visual Interpretation;

UNIT II Marginal Information of Satellite Imageries

UNIT III Interpretation of Satellite Imageries: Visual Interpretation; WaterResources, Lineaments, Land use / Land cover – Landforms – WasteLand. Digital Image Interpretation- Subset Supervised classification and Un- Supervised classification change Detection.

UNIT IV Aerial photo interpretation

1. Vision test – Stereo Test with Stereoscopes
2. Interpretation of Physical Features
3. Interpretation of Cultural Features

Suggested Readings

1. Curran, Paul, J. : Principles of Remote Sensing: Longman, London, 1985.
2. Gautam N.C. et al. Space Technology and Geography; National RemoteSensing Agency, Hyderabad, 1994.
3. Thomas M. Lillesand and Ralph, W. Keffer; Remote Sensing and imagesinterpretation, John Willey & Son s, New York, 1994.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	2	2	3	2	3	3
CO_2	3	3	3	3	3	3	2	2	3	2	3	3
CO_3	3	3	3	3	3	3	2	2	3	2	3	3
CO_4	3	3	3	3	3	3	2	2	3	2	3	3

MULTI DISCIPLINARY COURSE/PROJECT WORK

GEG 405: INTERNSHIP PROJECT WORK AND VIVA VOCE

Learning objectives:

- To help to understand geo spatial technologies applications in different geographical areas.
- To assist to select the project and completing project and report writing.

Learning Outcomes:

After the completion of the course, Students will be able to

- Develop geo spatial technologies applications in different geographical areas.
- Understand Selection of the project, complete the project and report writing.

SYLLABUS

1 The students of M.Sc. Geography 4th Semester have to collaborate with various firms/ Companies/ Research organizations /NGOs and complete internship on Geospatial techniques

2. The students of M.Sc. Geography 4th Semester may have to be selected a specific theme/topic for a Project Work based on the internship completed. The students may select some of the following themes for their project.

a. Land Evaluation
b. Land-use / Land cover Analysis
c. Water Sources
d. Slope Studies
e. Climatic Change
f. Settlement Studies
g. Agriculture Studies
h. Health Studies
i. Infrastructure Studies
j. Vegetation Studies
k. Transportation net work
l. Cropping pattern
m. Urban studies etc

3. GIS, GPS & RS methods have to be used with appropriate primary and secondary data.
4. The students should follow the research guidelines by reading Research Methodology before taking up the Project Work.
5. The Project should be around 50 pages including photos, references and tables.
6. Project work must include quality maps, diagrams and flowcharts.
7. The project report should include followings:

a) Title of the project
b) Introduction
c) Review of literature
d) Study Area
e)Objectives
f) Data sources
g) Materials and Method,
h) Results & Discussion
i) Conclusion
j) Appendices
k) Bibliography

Above work has to be done with the consultation of the staff-in-charge. Viva-Voice would be conducted at the semester end.

Suggested Readings:

1. Archer J.E. &dalton T.H. (1968): The fields work in Geography, E.t. Batsford Ltd., London.
2. Haring, Lloyed (1975): Scientific Geographic Research W C. Brow Company USA.
3. Johnes, P.A. (2008): Field Work in Geography, Longman.
4. Kothari C.R.(1996): Research Methodology, Vishwas Prakashan, New Delhi
5. Misra R.P. (1991): Research Methodology in Geography, concept pub. New Delhi.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	2	1	2	2	3	3
CO_2	3	3	3	3	3	3	2	1	2	2	3	3
CO_3	3	3	3	3	3	3	2	1	2	2	3	3
CO_4	3	3	3	3	3	3	2	1	2	2	3	3

OPEN ELECTIVE (OPT - 1)

GEG 406(A): REGIONAL GEOGRAPHY OF INDIA

Learning objectives:

- To explain practical knowledge on Regional aspects of India...
- To help to understand Indian mineral resources and their distribution..
- To illustrate Indian agriculture and cropping techniques.
- To acquaint knowledge on allocation of RS in different fields and sectors.

Learning Outcomes:

After the completion of the course, Students will be able to

- Explain practical knowledge on Remote sensing applications...
- Understand Visual and digital interpretation of satellite Images.
- Illustrate interpretation of Aerial photos.
- Acquaint knowledge on allocation of RS in different fields and sectors.

SYLLABUS

Unit I India: Location and Regional Geographical Setting of India**;** Development of Regional Studies; concept of region; Types of Region - formal region, nodal region, functional region. Regionalization-process, methods and techniques used for regionalization of formal regions and functional regions.

Unit I India: Mineral Resources – Coal, Iron ore and petroleum, Industries: Iron and Steel, Oil refinery and Paper industries; Industrial Regions of India.

Unit III Indian Agriculture – Green Revolution in Indian agriculture. Agriculture Types; Irrigation and Power; Multipurpose Projects. Major food grain crops; Rice and Wheat; Major commercial crops – Coffee and Tea. Regionalization of Agriculture - methods and techniques used in the analysis of crop combination regions, agricultural productivity regions.

Unit IV India: Population Distribution; Density growth problems, over population and population policies in India; Transportation and types and trade in regional context.

Suggested Readings

1. Spate, O.H.K., & Learrmonth, A.T.A., India & Pakistan, London.
2. Puri, G.S., Indian forest Ecology, New Delhi.
3. Ray Chaudhary, S.P. Land and soil, New Delhi
4. The Gazetteer of India Vo 1,.1
5. Krishnan, M.B. : Geology of India, Higginbothams, Madras.
6. Das, P.K., The Monsoon, New Delhi
7. Wadia, D.N., Geology of India, London.
8. Memoria, C.B. : Economic and Commercial Geography of India, Shirlal Agarwal and Co., Agra, 1991.
9. Alam, S.M. : Planning atlas of Andhra Pradesh.
10. Khullar: India, A comprehensive Geography. Kalyani Publishers, New Delhi.1989.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	2	1	2	2	3	3
CO_2	3	3	3	3	3	3	2	1	2	2	3	3
CO_3	3	3	3	3	3	3	2	1	2	2	3	3
CO_4	3	3	3	3	3	3	2	1	2	2	3	3

OPEN ELECTIVE (OPT - 1)

GEG 406(B): PRINCIPLES OF REMORE SENSING

Learning Objective

- To provide knowledge on history and evolution of Remote sensing
- To explains the principle involved in remote sensing i.e. the Electromagnetic spectrum, reflection, refraction, diffusion, absorption and interaction with earth's atmosphere.
- To provide knowledge on the platforms and sensors and instruments used for remote sensing
- To explain about the specifications remote sensing different satellites

Learning Outcomes

After the completion of the course, Students will be able to

- Develop knowledge on history and evolution of Remote sensing
- Explains the principle involved in remote sensing i.e. the Electromagnetic spectrum, reflection, refraction, diffusion, absorption and interaction with earth's atmosphere.
- Understand knowledge on the platforms and sensors and instruments used for remote sensing
- Illustrate about the specifications remote sensing different satellites.

P.T.O

SYLLABUS

UNIT I Introduction to Remote Sensing: History, Development and Principles Stages in Remote sensing Process..Stages in Remote Sensing Process. Energy Sources and Radiation Principles-Energy Interaction in the Atmosphere. Atmospheric Windows. Energy Interaction with Earth Surface features. Electromagnetic Spectrum. Spectral reflectance patterns of Earth surface features in different wavelength

UNIT II Aerial Remote Sensing - History and Types of Aerial Photographs Scales of Aerial Photographs Geometry of Aerial Photographs, Scale Distortions Photographic Resolution Aerial Photo interpretation Techniques-Photo recognition ,Photo Interpretation Equipment.

UNIT III Satellite Remote Sensing: Types of Satellites, Orbits: Types of Orbits, and Orbital characteristics Platforms: types of Platforms in Remote sensing .Sensors-Definition, Types of sensors in Remote sensing. Scanning mechanism. Resolutions: Definition, Spectral ,Spatial, Temporal and Radiometric resolutions of Satellites.

UNIT IV Characteristics of Indian Remote Sensing Satellites(I.R.S),LANDSAT ,etc Principles of Image Interpretation: Elements of Image Interpretation, Digital Image Processing. Applications in Land use Land Cover Mapping and Urbanisation

Suggested Readings

1. Lillisand T.M and Keifer R.W, (1994), Remote Sensing and Image Interpretation, Jhon Willey & sons, New York.
2. Rampall, K.K. (1999), hand book of Aerial Photography and Interpretation, Concept Publishing Co., New Delhi.
3. Sabins, F.F. Jr, (1987), Remote Sensing; Principles and Interpretation, W.h. Freeman & Co., New York.
4. Jenson R. Jhon, (2003), Remote Sensing of the Environment-An Earth Resource Perspective, Pearson Education Pvt. Ltd., Indian Branch, Patparganj, Delhi, India.
5. LRA Narayanan, Remote sensing and its Applications, (1999), Universities Press (India) Ltd., Hyderabad.
6. http://rst.gsfc.nasa.gov/Front/tofc.html.
7. http://earthobsevatory.nasa.gov/Library/RemoteSensing

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	3	2	3	2	3	3
CO_2	3	3	3	3	3	3	3	2	3	2	3	3
CO_3	3	3	3	3	3	3	3	2	3	2	3	3
CO_4	3	3	3	3	3	3	3	2	3	2	3	3

Annexure-I

Sri Venkateswara University College of Arts, Tirupati
Centre for Women's Studies

Dt. 08th January 2022

Minutes of the Board of Studies Online Meeting held between 03.15 PM and 05.00 PM on Saturday, 8th January 2022 through Zoom Platform

Agenda:

Approval of Syllabus and Model question papers for the Revised Syllabus to be implemented from the Academic year 2021-22 for the First and Second Semesters and from the Academic years 2022-23 for the Third and Fourth Semester Students of M. A. Women's Studies and Management being offered by the Centre for Women's Studies as per the guidelines issued under NEP-2020-21

Members Present:

1. Prof. D. Krishnamoorthy,
   Director, Centre for Women Studies
   &
   Chairperson, BOS in Women Studies

2. Prof. N. Manimekalai
   Head and Director
   Department of Women Studies
   Bharathidasan University
   Tiruchirapalle, Tamil Nadu

3. Prof. G. Sandhya Rani
   Head, Department of Women Studies &
   Member, BOS in Women Studies
   Padmavathi Mahila Visvavidyalayam
   Tirupati

Resolution:

1. It was unanimously resolved to approve the enclosed Revised Scheme, Syllabus and Model Question Papers for all the four semesters as per NEP 2020 guidelines for M. A. Women's Studies and Management being offered by the Centre for Women's Studies and the same may be implemented from the Academic Year 2021-22 for the First and Second Semesters and from the Academic years 2022-23 for the Third and Fourth Semester Students;
2. It was also unanimously resolved that all Arts, Commerce, Management, and Science students are eligible to take up the Open Elective Papers offered by the Centre for Women's Studies.
3. It was resolved to introduce the course "Principles of Management" as a new course replacing the existing course "Social Work Initiatives for Women's Development"
4. It was further resolved to amend the course titles as per the suggestions of the BoS Members to focus on Gender Concerns, biases, discrimination, analysis etc.

Signatures with Date:

1. Prof. D. Krishnamoorthy,
2. Prof. N Manimekalai — N. Manimekalai
3. Prof. G. Sandhya Rani — G. Sandhya Rani

Chairperson, BOS and the Director — 10/01/2022

DIRECTOR
CENTRE FOR WOMEN'S STUDIES
S.V. UNIVERSITY, TIRUPATI.

ENV-305- COMPUTER APPLICATIONS AND TOXICOLOGICAL STUDY IN FOOD ADULTERATION
(Skill Oriented Course)

UNIT - 1

Computer and application in toxicology: Introduction to computers, basic unit and functions, H/W and S/W, operating systems, word processing, spread sheet, graphic programs, dbase, windows, statistical S/W programs and packages. Steps involved in S/W development, computer languages with emphasis to FORTRAN language and programming,

UNIT- II

Toxicology software systems. Use of computers in information retrieval systems, Technology development: Technology development-meaning; Drug related technology development; Toxicological studies, bioequivalence (BU), clinical trials-phase-I, phase-II and phase-III.

UNIT –III (P)

Detection of milk adulteration - Detection of starch in milk and milk products (khoya,chenna, paneer) - Detection of mashed potatoes, sweet potatoes and other starches in ghee/butter - Detection of sugar solution in honey - Detection of chalk powder in sugar/pithi sugar/jaggery - Detection of excess bran in wheat flour - Detection of added colour in food grains - Detection of rhodamine B in ragi.

UNIT-IV (P)

Detection of papaya seeds in black pepper - Detection of artificial/water soluble synthetic colours in chilli powder - Detection of saw dust in chilli powder - Detection of chalk in common salt - Detection of artificial colour in turmeric powder - Detection of malachite green in green vegetables like bitter gound, green chilli and others - Detection of artificial colour on green peas - Detection of rhodamine B in sweet potato.

References

1. Advances in Molecular Toxicology by James C. Fishbein
2. Operating Systems: Internals and Design Principles by Stallings (Pearson)
3. Handbook of Food Adulteration and Safety Laws by Sumeet Malik
4. Molecular Toxicology by P. David Josephy .
5. Adulteration Analysis of some foods and drugs
6. Frontiers in drug safety volume 1 by Alankar Shrivastava
7. A.K. De. Environmental Chemistry, 1985
8. Sharma, B.K. Kaur H., Environmental Chemistry, Goel Publishing House (1995).'
9. Sharma.P.D., Environmental Biology and Toxicology, Rastogy (1994).

SRI VENKATESWARA UNIVERSITY:: TIRUPATI SVU

COLLEGE OF SCIENCES

DEPARTMENT OF PHYSICS

Syllabus for M.Sc. PHYSICS Choice Based

Credit System (CBCS)

Amended as per NEP-2020

(w.e.f. the Academic Year 2021-2022)

Vision

To inculcate certain specific enabling skill sets to prepare the students to take up challenges in any one or more functional domains viz. (i) Academics; (ii) Basic and Applied Research; (iii) Research & Development; (iv) Engineering & Technology and (v) Industry.

Mission

To bring out professionals having knowledge of basic laws of nature together with strong fundamentals in the core area of physics viz. Classical Mechanics, Quantum Mechanics, Condensed Matter Physics, Electromagnetism, Computational Physics, Statistical Physics, Spectroscopy, Photonics, Thin film Technology and Solar Energy Physics, Electronics, Atomic and Nuclear Physics and advanced level topics such as High Energy Physics, Nanotechnology, Nonlinear Optics, etc.

PROGRAM EDUCATIONAL OBJECTIVES: At the end of the program, the student will be able to:

PEO1	Apply principles of basic scientific concepts in understanding, analysis, and prediction of physical systems.
PEO2	Develop human resource with specialization in theoretical and experimental Techniques required for career in academic, research and industry.
PEO3	Engage in lifelong learning and adapt to changing professional and societal needs.

PROGRAM OUT COMES: At the end of the program, the student will be able to:

PO1	Apply the scientific knowledge to solve the complex physics problems.
PO2	Identify, formulate, and analyze advanced scientific problems reaching substantiated Conclusions using first principles of mathematics, physical, and natural sciences.
PO3	Design solutions for advanced scientific problems and design system components or processes that meet the specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal consideration.
PO4	Use research-based knowledge and methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Create, select, and apply appropriate techniques, resources, and modern scientific Tools to complex physics problems with an understanding of the limitations.
PO6	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to the Professional scientific practice.
PO7	Understand the impact of the scientific solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Apply ethical principles and commit to the norms of scientific practice.
PO9	Function effectively as an individual, and as a member or leader in diverse teams, And in multidisciplinary settings.
PO10	Communicate effectively on scientific activities with the Scientific/Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective representations, and give And receive clear instructions.

PO11	Demonstrate knowledge and understanding of the scientific principles and apply These to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Recognize the need for, and have the preparation and ability to engage in independent And life-long learning in the broadest context of scientific cand technological change.

PROGRAM SPECIFIC OUT COMES: At the end of the program, the student will be able to:

PSO1	Understand the basic and advance concepts of different branches of physics.
PSO2	Perform and design experiments in the areas of electronics, atomic, nuclear, Condensed matter, and computational physics.
PSO3	Apply the concepts of physics in specialized areas of condensed, nuclear, renewable energies, particle physics, etc. in industry, academia, research and day to day life.

SRI VENKATESWARA UNIVERSITY:: TIRUPATI
DEPARTMENT OF PHYSICS
TWO YEAR M.Sc. COURSE IN PHYSICS (2021-2022)
SCHEME

Semester -I

S.No	Components of Study	Title of the Course	Title of the Paper	Credit Hrs /Week	No. of Credits	IA Marks	Sem End Marks	Total
1.	**Mandatory Core**	PHY101	1.ClassicalMechanicsandTheoryof Relativity	6	4	20	80	100
2.		PHY102	2.Solid State Physics	6	4	20	80	100
3.	**Compulsory Foundation**	PHY103(a)	1.Analogand Digital Electronics	6	4	20	80	100
		PHY103(b)	2.Computational Methods & C Language					
		PHY103(c)	3.Sensors and Transducers					
4.	**Elective Foundation**	PHY104(a)	1.Atomic and Molecular Physics	6	4	20	80	100
		PHY104(b)	2.Optical, Micro wave and Satellite Communications					
		PHY104(c)	3.Computer Architecture and Networking					
5.	**Practical-I**	PHY105	Paper1&3 (General Lab)	6	4	--	100	100
6.	**Practical-II**	PHY106	Paper3 &4 (Electronics Lab)	6	4	--	100	100
	Total			36	24	80	520	600
7.	Audit Course			0	0	100	0	0

*All core papers are Mandatory

- Compulsory Foundation choose one paper.
- Elective Foundation–Choose one paper.
- Auditcourse-100Marks (Internals) Zero Credits under self-study.
- Interested students may register for MOOC with the approval of the concerned DDC but it will be considered for the award of the grade as open elective only giving extra credits.

S.No	Components of Study	Title of the Course	Title of the Paper	Credit Hrs/ Week	No. of Credits	IA Marks	Sem End Marks	Total
1.	**Mandatory Core**	PHY201	1. Statistical Mechanics	6	4	20	80	100
2.		PHY202	2.EM Theory, Lasers & Modern Optics	6	4	20	80	100
3.	**Compulsory Foundation**	PHY203(a)	1.NuclearPhysics	6	4	20	80	100
		PHY203(b)	2.ICfabrication Techniques					
		PHY203(c)	3.AdvancedMicroprocessors and its Applications					
4.	**Elective Foundation**	PHY204(a)	1.Mathematical Physics	6	4	20	80	100
		PHY204(b)	2.Introductionto VLSI design					
		PHY204(c)	3.MaterialScience For Industrial Applications					
5.	**Practical-I**	PHY205	Paper1&3 (General Lab)	6	4	--	100	100
6.	**Practical-II**	PHY206	Paper3&4 (Electronics Lab)	6	4	--	100	100
	Total			36	24	80	520	600
7.	Audit Course			0	0	100	0	0

*All core papers are Mandatory

- Compulsory Foundation choose one paper.
- Elective Foundation–Choose one paper.
- Auditcourse-100Marks (Internals)Zero Credits under self-study.
- Interested students may register for MOOC with the approval of the concerned DDC but it will be considered for the award of the grade as open elective only giving extra credits.

S.No	Components of Study	Title of the Course	Title of the Paper	Credit Hrs/ Week	No. of Credits	IA Marks	Sem End Marks	Total
1.	**Mandatory Core**	PHY301	1.Introductory QuantumMechanics	6	4	20	80	100
2.		PHY302	2.Physics of Semiconductor Devices	6	4	20	80	100
3.	**Generic Elective**	PHY303(a)	1.Applied Spectroscopy	6	4	20	80	100
		PHY303(b)	2.Condensed Matter Physics					
		PHY303(c)	3.Embedded Systems					
4.	**Practicals**	PHY304	Elective Lab	6	4	--	100	100
5.	**Skill Oriented Course**	PHY305	Advances in Physics	6	4	10	90(T40 +P50)	100
6.	**Open Elective**	PHY306(a)	1.Basic Spectroscopic Techniques	6	4	20	80	100
		PHY306(b)	1. Nano materials and Devices					
	Total			36	24	90	510	600

*All core papers are Mandatory

- Generic Elective– Choose two
- Core papers and Generic Electives opted paper held Practical-I
- Skill Oriented Course is Mandatory. Relevant society along with practical (10marksinternal40 final theory& 50 for practical's).
- Open Electives are for the students of other Departments. Minimum one paper should be opted. Extra credits may be earned by opting for more number of open electives depending on the interest of the student through self-study.
- Interested students may register for MOOC with the approval of the concerned DDC.

S.No	Components of study	Title of the Course	Title of the Paper	Credit Hrs/ Week	No. of Credits	IA Marks	Sem End Marks	Total
1.	**Mandatory Core**	PHY401	1.Advanced QuantumMechanics	6	4	20	80	100
2.		PHY402	2.Physicsof Advanced Materials	6	4	20	80	100
3.	**Generic Elective**	PHY403(a)	1.Photonics	6	4	20	80	100
		PHY403(b)	2.SolarEnergy-Thermal and Photovoltaic Properties					
		PHY403(c)	3.Vacuumand ThinFilm Technology					
4.	**Practicals**	PHY404	Elective Lab	6	4	--	100	100
5.	**Multi Disciplinary Course/ Project Work**	PHY405	Advanced Characterization Techniques	6	4	10	90(T 40+P 50)	100
6.	**Open Elective**	PHY406(a)	1.Wireless Communications	6	4	20	80	100
		PHY406(b)	2. Vacuum Technology & Applications					
	Total			36	24	90	510	600

*All core papers are Mandatory

- Generic Elective –Choose two
- Core papers and Generic Electives opted paper held Practical-II.
- Project Work-Collaboration with various firms/companies/societies.
- Multi-Disciplinary Course is Mandatory. Circle formation with other subjects/ Dept. of Arts / Commerce.
- Open Electives are for the students of other Departments. Minimum one paper should be opted. Extra credits may be earned by opting for more number of open electives depending on the interest of the student through self-study.
- Interested students may register for MOOC with the approval of the concerned DDC.

(Mandatory Core)

PHY-101	CLASSICALMECHANICS AND THEORY OF RELATIVITY	L-5,T-1,P-0	4Credits

Pre-requisite: Understanding of graduate level physics

Course Objectives: The aim and objective of the course on **Classical Mechanics and theory of relativity** is to train the students of M.Sc. in the Lagrangian and Hamiltonian formalisms and relativity theory so that they can use these in the modern branches of physics such as Quantum Mechanics, Quantum Field Theory, Condensed Matter Physics, Astrophysics, etc.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the necessity of Action, Lagrangian, and Hamiltonian formalism.
CO2	Used' DAlambertprincipleandcalculusofvariationstoderivetheLagrangeequationsof motion.
CO3	Describe the motion of a mechanical system using Lagrange-Hamilton formalism.
CO4	Apply essential features of a relativity problem (like motion under central force, periodic motions) to set up and solve the appropriate physics problems.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	1	1	-	2	2	2	2
CO2	3	2	2	2	2	1	1	-	2	2	2	2
CO3	3	2	2	2	2	1	1	-	2	2	2	2
CO4	3	2	2	2	1	1	1	-	2	2	2	2

PHY101:Classical Mechanics and Theory of Relativity

UNIT–I: Lagrangian Mechanics and Hamiltonian Mechanics

Newtonian mechanics of one and many particle systems: Conservation laws: Constraints and their classification: Degrees of freedom: Generalized coordinates: Principle of virtual work, D' Alemberts principle: Lagrange's equations of motion.

Applications: Inclined plane, Linear harmonic oscillator and simple pendulum: Hamiltonian principle: Lagrange's equation from Hamilton's principle: Hamilton's equation of motion: Applications: Simple pendulum, Compound pendulum.

UNIT–II: Canonical Transformations and Hamilton – Jacobi Theory

Canonical Transformations; generating function; properties: Condition for transformation to be canonical; Illustration of canonical transformation: Poisson - Brackets; Canonical equations in terms of Poisson - Bracket notation. Lagrange-Brackets and their properties.

The Hamiltonian - Jacobi equation; one dimensional harmonic oscillator; Action Angle variables: Kepler problem in action angle variables

UNIT–III: Motion in a Central Force Field

Reduction to the equivalent one body problem; Motion in a central force field: Conditions for closed orbits: Inverse square law of forces: Kepler's laws of planetary motion; Rutherford scattering.

Rotations – Space and body fixed axes: Angular momentum and Torque; Eulerian angles– Euler's equations of a rigid body: Motion of symmetrical top; Expression for slow and fast precessions; Larmour precision; Examples of Gyroscope.

UNIT–IV: Special Theory of Relativity

Introduction – Postulates of Special Theory of Relativity – The principle of constancy of light – The Lorentz transformations. Relativistic Kinematics: The velocity transformations–The transformations for the acceleration of a particle. Relativity Optics: The aberration of the of the light from stars – The Doppler effect.

Relativistic Mechanics: The mass of a moving particle – The relativistic dynamics of a single particle – Applications of relativistic dynamics of a single particle: Motion in electric field – Motion in a magneticfield–Experimentalverificationofthevariationofmasswithvelocity–Bucherer'sexperiment-Transformation of momentum and force.

Books for Study

1. Classical Mechanics by N.C. Rana and P.S. Joag Tata Mc- graw Hill(1991).
2. Classical Mechanics by H.Goldstein, AddiWesely,(1980).
3. Classical Mechanics by J.C.Upadyaya, Himalaya Publishing House(2014).
4. Classical Mechanics by Gupta, Kumar and Sharma, Pragati Edition,(2019).
5. Classical dynamics of particles and systems by J.B.Marion, Thomson Books/ cole,(2004).
6. Introduction to Classical Mechanics by R.G. Takwale and P.S.Puranik, Tata Mc-grawHill,(2008).
7. Theory of Relativity by W.Pauli, Dover Publications,(2013).
8. Introduction to the theory of relativity by P.G.Bergmann, Dover Publications(1977).
9. Introductory Relativity by W.G.V. Rosser, London Butterworths,(1967).

(Mandatory Core)

PHY-102	Solid State Physics	L-3,T-1,P-2	4Credits

Pre-requisite: Understanding of graduate level solid state physics

Course Objectives: The aim and objective of the course on **Solid State Physics** is to expose the students of M.Sc. class to the topics like elastic constants, lattice vibrations, dielectric properties, energy band theory and transport theory so that they are equipped with the techniques used in investigating the sea aspects of the matter in condensed phase.

Course Outcomes: At the end of the course, the student will be able to

CO1	Gain in-depth knowledge about the formation of various crystal structure vaper forming calculations on their elemental parameters.
CO2	Differentiate between various lattice types based on their lattice dynamics and then explain thermal properties of crystalline solids.
CO3	Understand the electron motion in periodic solids and origin of energy bands in semiconductors.
CO4	To explain the basic transport theory for understanding the transport phenomenon in solids

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1	2	1	2	2	2	1	2
CO2	2	2	2	2	2	2	2	2	2	2	2	2
CO3	2	2	1	2	1	2	2	2	1	2	1	2
CO4	2	2	1	2	2	2	1	2	1	2	2	2

PHY102:Solid State Physics

UNIT–I: Crystallography, Lattice Energies and Lattice Vibrations

Bravais lattices–Reciprocal lattice –X-ray diffraction –structural factor.

Origin of chemical binding in ionic and van der Waals crystals – Elastic properties – Stress and strain – Elastic moduli - Lattice energy calculations for ionic and van der Waals crystals – Lattice vibrations: Mono and diatomic one dimensional infinitely long lattices–Quantization of lattice vibrations–Phonons –Properties.

UNIT– II: Transport Phenomena and Band Theory

Concept of electrical and thermal resistivity – Expression for thermal and electrical conductivities for metals – Lorenz number - Different scattering mechanisms – Matheissens rule- Distribution function - Formulation of Boltzmann transport equation– Relaxation time approximation.

Sommerfeld model – its consequences – electron-lattice interaction (Quantitative only) – Bloch function - Motion of electron in periodic potential –Kronig - Penny model – Formation of energy bands in solids – Brillouin zones–Concept of effective mass –Distinction between metals, insulators and semiconductors.

UNIT–III: Semi conduct or Physics

Intrinsic and extrinsic semiconductors–Expression for position of Fermi levels and carrier concentrations – Variation of Fermi level with temperature – np product – Carrier mobility, conductivity and their variation with temperature – Direct and indirect band gap semiconductors – Differences and examples – Hall effect - Continuity equation – Drift and Diffusion – Einstein relation – Generation, Recombination and life time of non-equilibrium carriers – Heyness- Schockley experiment – Determination of life time, diffusion length of minority charge carriers.

UNIT–IV: Super conductivity

Concept of zero resistance–Magnetic behavior–Distinction between a perfect conductor and superconductor–Meissnereffect–Isotopeeffect–Specificheatbehavior–Two-fluidmodel–Expression for entropy difference between normal and superconducting states – London's equations –Penetration depth – BCS theory –Josephson junctions – SQUIDS and its applications - Applications ofsuperconductors –High $T_C$superconductors–Preparation– Properties.

Books for Study

1. Solid State Physics, C.Kittel, Edition:8th 2012, John Wiley & Sons.
2. Solid State Physics, A.J.Dekkar, Edition: 1st,2000.Macmillan India Ltd.
3. Solid State Electronic Devices, B.G.Streetman. Edition 7th,2018,Pearson Education India
4. Elementary Solid State Physics, M.Ali Omar,1993,Addison-Wesley.
5. Solid State Physics, M.A.Wahab, Edition:3rd, 2020,NarosaPublishingHouse.
6. HighT_C Super conductivity, C.N.R.Rao and S.V.Subramanyam, world scientific publishing company,1989
7. Solid State Physics, S.O.Pillai.Edition:6th,2009, New Academic Science Ltd
8. Solid State Physics, S.L.Kakani and C.Hemarajan, Edition: 4th,2005,Sultan Chand andSons
9. Electrons in Solids, Richard H.Bube,Edition 3rd,1992 Elsevier,
10. Solid State Physics by R.K. Puri V.K. Babbar Edition: 1st 2017. S.Chand.

(Compulsory Foundation)

PHY-103(a)	Analog and Digital Electronics	L-5,T-1,P-6	4Credits

Pre-requisite: Basic knowledge about electronics

Course Objectives: The aim and objective of the course on **Analog and Digital Electronics** is to introduce the students of M.Sc. class to the formal structure of the subject and to equip them with the knowledge of semiconductor physics, basic circuit analysis, first-order non linear circuits, OPAMP based analog circuits and introduction to digital electronics so that they can use these in various branches of physics as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand working of Different Semiconductor devices (Construction, Working Principles and V-I characteristics) and their applications.
CO2	Explain the construction and working of Operational amplifiers and applications
CO3	Design Digital circuits and their applications.
CO4	Understand the working of various analog communication techniques

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	2	1	2	1	2	2	2
CO2	3	3	2	1	2	2	1	2	1	2	2	2
CO3	2	2	3	2	2	2	1	2	1	2	2	2
CO4	3	3	2	1	2	2	1	2	1	2	2	2

PHY103(a): Analog and Digital Electronics

UNIT–I: Introduction to Electronic Devices:

Field Effect Transistor (FET): Structure and working of JFET, Characteristics, and parameters of JFET. Advantages of FET over BJT. FET as switch and Amplifier-Application of FET as voltage variable resistor. Structure of MOSFET, depletion type and enhancement type, MOSFET Characteristics, MOSFET as variable resistor, Concept of CMOS. Structure, working and Characteristics of UJT. Application of UJT as a Relaxation oscillator.

UNIT–II: Operational Amplifiers:

Block diagram of a typical Op-Amp, differential Amplifier, Comparator open loop configuration, inverting and non-inverting amplifiers. Op-amp with negative feedback, voltages hunt feedback, effect of feedback on closed loop gain, input resistance, output resistance, CMRR, frequency response, slewrate.

Instrumentation Amplifier, integrator and differentiator. Wave form generators (Square and triangle). Filters (Low pass, high pass and Band pass). Analog to Digital data converters (ADC)and Digital to Analog conversion (DAC).

UNIT–III: Digital Electronics

(Compulsory Foundation)

Combinational Logic: Multiplexers, Decoder, Demultiplexer, Data selector, Multiplexer, Encoder. Sequential Logic: Flip–Flops, A1-bit memory, The RS Flip-Flop, JK Flip – Flop, JK Master Slave Flip–Flops, T Flip-Flop, D Flip-Flop, Shift Registers, Serial-in Serial-out, Serial-in Parallel-out, Parallel-in Serial-out, Parallel-in Parallel-out Registers. Asynchronous and Synchronous Counters.

UNIT–IV: Communication Electronics

Introduction to Modulation (AM & FM), Sampling Theorem, Low pass and Band pass signals, PAM, Channel BW for a PAM signal. Natural sampling, Flat-top sampling. Signal recovery through holding. Quantization of signals, PCM transmission, Quantization of noise, Differential PCM, Delta Modulation, Adaptive Delta modulation CVSD. Signal to noise ratio in PCM and Delta Modulations.

Books for Study

1. Micro Electronics by Milliman and Halkias.TMH Publications
2. OP-Amps & Linear Integrated Circuits, by Ramakanth A.Gayakwad,PHI,2ndEdition,1991.
3. Digital Systems by Ronald J. Tocci, 6thEdition, PHI, 1999.
4. Digital Principles and Applications by A.P. Malvino and Donald P.Leach, Tata McGraw-Hill, New Delhi, 1993.
5. Principles of Communications by Taub and Schilling, Mc-GrawHill Publication.
6. Electronic Devices and Circuit Theory by Robert Boylested and Louis Nashdsky–Jose Kanedy & Division. PHI, New Delhi, 1991
7. Electronic Principles by Malvino, 6thEd.TMH, 2017
8. Linear Integrated circuits by Roy Choudhry, Pearson,2018
9. Op-Amps – D.K. Mahesh, PHI

(Compulsory Foundation)

PHY-103(b)	Computational Methods and C language	L-5,T-1,P-0	4Credits

Pre-requisite: Understanding of graduate level physics

Course Objectives: The aim and objective of the course on **Computational Methods and C language** is to familiarize the students of M.Sc. students with the numerical methods used in computation and programming using any high level language such as C,etc., so that they can use these in solving simple physics problems.

Course Outcomes: At the end of the course, the student will be able to

CO1	Apply basics knowledge of computational physics in solving the physics problems.
CO2	Programme with the C or any other high-level language.
CO3	Use various numerical methods in solving physics problems.
CO4	Analyze the outcome of the algorithm/program graphically.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	1	1	2	3	2	3	2
CO2	3	3	3	1	2	1	1	1	3	2	3	2
C O3	3	3	3	2	2	1	1	2	1	2	2	2
CO4	3	3	3	3	2	2	2	2	2	2	2	2

PHY103(b):Computational Methods & C Language

UNIT–I:(a) Fundamentals of C language

C character set–Identifiers and keywords–Constants–Variables–Datatypes–Declarations of variables–Declaration of storage class–Defining symbolic constants–Assignment statement. Operators: Arithmetic operators–Relational operators–Logic operators–Assignme nt operators–Increment and decrement operators–Conditional operators.

(b) Expressions and I/O statements: Arithmetic expressions–Precedence of arithmetic operators–Type converters in expressions–Mathematical(library) functions–Data input and output -Get char and put char functions– Scan f– Print f–Simple programs.

(c) Control statements: If-Else statement – Switch statement – The? operator – GO TO – While, Do-while, FOR statements – BREAK and CONTINUE statements.

UNIT–II:(a) Arrays

One dimensional and two-dimensional arrays – Initialization – Type declaration – Inputting and outputting of data for arrays– Programs of matrices addition, subtraction and multiplication.

(b) User Define functions: The form of C functions – Return values and their types – Calling a function – Category of functions. Nesting of functions. Recursion. ANSI C functions –Function declaration. Scope and lifetime of variables in functions.

(c) Pointers: Accessing the address of variable. Declaration and Initialization of pointer variables. Accessing the value of the variable through its pointer. Pointer Expressions- Pointers

and Arrays – Pointers and structures.

UNIT– III: Linear and non-linear equations

(a) Solution of Algebraic and transcendental equations – Bisection, Falsi position and Newton-Rhapson methods– Basic principles– Formulae–Algorithms.

(b) Simultaneous equations: Solutions of simultaneous linear equations – Gauss elimination and Gauss-Seidel iterative methods -Basic principles –Formulae–Algorithms

UNIT–IV:(a) Interpolations

Concept of linear interpolation – Finite differences – Newton's and Lagrange's interpolation formulae –Principles and Algorithms Curve fitting – regression – Least square fitting – Linear and quadratic.

(b) Numerical differentiation and integration: Numerical differentiation –algorithm for evaluation of first order derivatives using formulae based on Taylor's series – Numerical integration– Trape zooidal and Simpson's1/3 rule – Formulae–Algorithms.

(c) Numerical solution of ordinary differential equations: Euler, method, Fourth order Runga-Kutta Method.

Books for Study

1. Programming with 'C'–Byron Gottfried, 4th Edition, Tata Mc Graw Hill, 2010.
2. Programming in 'C' –Balaguruswamy,8th Edition, Tata Mc Graw-Hill,1990.
3. Numerical Methods, E. Balaguru swamy, Tata Mc GrawHill,1999.
4. Computer oriented numerical methods–Raja Raman,4th Edition, PHILearning,2018.
5. Let Us C, Yeswanth Kanetkar,17th Edition, Infinity Science Press, 2008.

(Compulsory Foundation)

PHY-103©	Sensors and Transducers	L-3,T-1,P-2	4Credits

Pre-requisite: Understanding of graduate level physics

Course Objectives: The aim and objective of the course on Sensors and Transducers is to familiarize the students of M.Sc. students with the various electronic sensors used in the industry and to understand the working principles of the sensors so that they can design and use them in industry or in real time applications.

Course Outcomes: At the end of the course, the student will be able to

CO1	Apply basics knowledge of sensors and transducers in understanding the measurement systems.
CO2	Study and understanding of various types of sensors
CO3	Study and understanding of various types of Transducers
CO4	Analyze the outcome of the signal conditioners like filters, detectors and amplifiers

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	1	1	2	3	2	3	2
CO2	3	3	3	1	2	1	1	1	3	2	3	2
CO3	3	3	3	2	2	1	1	2	1	2	2	2
CO4	3	3	3	3	2	2	2	2	2	2	2	2

PHY103(c):Sensors and Transducers

UNIT–I: General Introduction to sensors/transducers

Definition of a transducer/sensor. Role of a transducer in a generalized measurement system. Classification of transducers. Classification of transducers. Significant parameters of transducer. Temperature scales. Mechanical temperature sensors. Platinum resistance thermometer. Thermistors. Thermocouples.

UNIT–II: Displacement and strain transducers

Displacement transducers- Variable resistance, inductance and capacitance. Linear voltage differential Transformer (LVDT) Strain- Definition, Principal of working of strain gauges. Gauge factor. Types of strain gauges. Materials for strain gauges. Temperature compensation. Application

UNIT–III: Opto-electronic transducers

Photoemission tube. Photomultiplier cell. Photo conductive cell. Photo voltaic cell (solar cell).

Photodiode, Photo–transistor, Photo FET, Light emitting diode. Liquid crystal display. Opto electronic couplers. Laser diode.

UNIT–IV: Single conditioners (Filters, Detectors & Amplifiers)

Filters – Integrators, Differentiators and active filters. Detectors Peak Detectors sample and _hold circuits. Phase sensitive detector and precision rectifiers, Amplifiers– chopper stabilized DC amplifiers. Instrumentation amplifiers. Logarithmic and anti-logarithmic amplifiers Isolation amplifiers, Lock in amplifiers.

Books for Study

1. Instrumentation Measurement Analysis, NakraandChaudary,4th Edition, TataMcGraw-Hill,1985.
2. Instrumentation- Devices and Systems, Rangan, Mani and Sharma,2nd Edition, Tata Mc GrawHill,1983.
3. A course in Electrical and Electronic Measurements and Instrumentation, AK Sawhney, 4th Edition, Dhanpat Rai & Company, 2016.
4. Instrumental Methods of Analysis, Willard, Meritt, Dean and Seattle,7th Edition, Van Nostr and,1981.
5. Hand Book of Biomedical Instrumentation, RS Khandpur,3rd Edition, Tata Mc Graw-Hill,1987.
6. Fundamentals of Electronic Devices, David A. Bell, 5th Edition, Oxford University Press,2008.
7. An introduction to Operational amplifiers, SV Subramanyam,2nd Edition, Macmillan India,1980.

(ElectiveFoundation)

PHY-104(a)	Atomic and Molecular Physics	L-5,T-1,P-0	4Credits

Pre-requisite: Understanding of graduate level spectroscopy

Course Objectives: The aim and objective of the course on **Atomic and Molecular Physics** for the students of M.Sc. Physics is to equip them with the knowledge of Atomic, Rotational, Vibrational, Raman, and Electronic spectra.

Course Outcomes: At the end of the course, the student will be able to

CO1	Have the basic knowledge of different atomic models, quantum nos and atomic spectra.
CO2	Understand the classical/quantum description of effect of magnetic field and Electric field on spectral lines.
CO3	Know the different types of rotation of the molecules and rotational constants and intern structure of the molecules.
CO4	Study the vibrational spectra of molecules and applications of vibrational spectra of molecules and applications of vibrational spectra

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	2	1	1	2	2	3	1	2
CO2	2	2	3	3	2	1	2	2	2	3	1	1
CO3	2	2	3	3	2	1	2	2	2	3	1	3
CO4	2	2	3	3	2	1	2	2	2	3	1	3

PHY104(a): Atomic and Molecular Physics

UNIT-I: Atomic Spectra

Introduction: Hydrogen atom (one electron atom) - quantum numbers- Spectra of hydrogen atom- Spectra of alkali elements- Fine structure-Elements with more than one valence electron- Forbidden transitions and selection rules- Vector atom model– Spin-orbit interaction energy- Stern-Gerlach experiment-Experimental setup to demonstrate S-G - Coupling schemes- Spectral terms and term symbols based on electron configuration - LS coupling - JJ coupling- Interaction energies in LS and JJ couplings - Hund's rule of multiplicity- Pauli's exclusion principle-Equivalent and non-equivalent electronic systems.

UNIT-II: Zeeman and Stark Effects

Introduction: Zeeman effect- Normal and anomalous Zeeman effects - Experimental details – Magnetic moment of atom and Lande's 'g'-factor - Zeeman effect in sodium atom - Lande g-formula for LS and JJcouplings-Paschen-Backeffect-Splittingofsodiumlinesandselectionrules-Starkeffect-Experimental details - Weak and strong field effects – linear and quadratic Stark effects-Width of spectral lines.

UNIT-III: Diatomic Molecular Spectroscopy–Rotational Energies

Introduction–Rotational, vibrational, electronic spectra of diatomic molecules–types of molecules–Linear, symmetric top, asymmetric top and spherical top molecules –Rotational spectra of a diatomic

(ElectiveFoundation)

molecule as rigid rotator– Energy levels and spectra of non-rigid rotor –Intensity of rotational lines-Rotational spectra of polyatomicmolecule–Rotationalanalysisofelectronicspectra-Evaluation of rotational constants-Effect of iso topic substitution on rotational levels–Stark splitting of rotational lines–Stark modulated microwave spectrometer – Applications of rotational spectroscopy

UNIT-IV: Diatomic Molecular Spectroscopy –Vibrational Spectra

Introduction–Vibrational spectra of diatomic molecule–Diatomic molecule as simple harmonic oscillator–An harmonic oscillator–Energy levels and spectrum– Molecule as vibrating rotator – PQR branches – progressions and sequences –Vibrational analysis of electronic spectra-Deslander's table–Evaluation of vibrational constants–Morse potential energy curve
– Frank-Condon principle – Intensity distribution in absorption and emission spectra -Effect of isotopic substitution on vibrational bands–IR spectrometer–FTIR spectroscopy–Principle–Interferometer arrangement–advantages- Applications of vibrational spectroscopy

Books for Study

1. Introduction to Atomic Spectra, H.E. White, McGraw-Hill Kogakusha. Ltd., New Delhi (1934).
2. Elements of Spectroscopy by Gupta, Kumar, Sarma, Pragati Prakasan,(2012).
3. Fundamentals of Molecular Spectroscopy, C.N. Banwell and E.M. Mc Cash, Tata McGraw-Hill Publishing Company Ltd., New Delhi.(1994).
4. Spectroscopy, Volume I and III, B.P. Straughan and S. Walker, John Wiley & Sons Inc., New York. (1976).
5. Introduction to Molecular Spectroscopy, G.M.Barrow, Mc Graw-Hill Book company, Inc., New York. (1962).
6. Spectra of Diatomic Molecules, G. Herzberg, D. Van Nostr and Company Inc, New York,(1950).
7. Molecular Spectroscopy, J.M.Brown, Oxford Science Publications, Oxford.(1998).
8. Molecular Structure and Spectroscopy, G. Aruldhas, Prentice- Hall of India, Pvt., New Delhi,(2005).

(ElectiveFoundation)

PHY-104(b))	Optical, Microwave and Satellite Communications	L-3,T-1,P-2	4Credits

Pre-requisite: Understanding of graduate level Basic Electronics

Course Objectives: The aim and objective of the course on Optical, Microwave and Satellite Communications for the students of M.Sc. Physics is to equip them with the knowledge of Optical, microwave and satellite Communications.

Course Outcomes: At the end of the course, the student will be able to

CO1	understand microwave communication system
CO2	Understand functioning of Radar systems
CO3	Study different digital modulation techniques
CO4	Differentiate losses in optical fiber link and state transmission characteristics of optical fiber

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	2	1	1	2	2	3	1	2
CO2	2	2	3	3	2	1	2	2	2	3	1	1
CO3	2	2	3	3	2	1	2	2	2	3	1	3
CO4	2	2	3	3	2	1	2	2	2	3	1	3

PHY104(b): Optical, Microwave and Satellite Communications

UNIT– I: Microwave Communications

Advantages and Disadvantages of microwave transmission, loss in free space, propagation of microwaves, atmospheric effects on propagation, Fresnelz one problem, ground reflection, fading Sources, Detectors, components, antennae used in MW communication systems.

UNIT–II: Radar Systems

Radar block diagram and operation, radar frequencies, pulse considerations. Radar range equation, derivation of the radar range equation, minimum detectable signal, receiver noise, Signal to noise ratio, Integration of radar pulses, Radar cross section, Pulse repetition frequency, Antenna parameters, System Losses and propagation losses, Radar transmitters, receivers, Antennas, Displays.

UNIT-III: Digital Communications

Digital Communications: Principles of digital communications, digital radio, frequency shift

keying, phase shift keying, quadrature amplitude modulation.

UNIT–IV: **Optical and Satellite Communications**

Optical Communications: Optical transmitter and receiver for analog and digital communications, coherent and non-coherent detection, signal to noise ratio, error rate, coding, synchronization and equalization in optical data transmission.

Satellite Communications: Orbital satellites, geo stationary satellites, orbital patters, look angles, orbital spacing, satellite systems, Link modules.

Books for Study

1. Microelectronics by Jacob Millman, 2nd Edition, Mc Graw-Hill International Book Co., New Delhi, 1990.
2. Optoelectronics: Theory and Practice, edited by Allen Chappel, 11th Edition, Mc Graw Hill, International Book Co., New York,1978.
3. Microwaves" by K.C. Gupta,2nd Edition, Wiley Eastern Limited, New Delhi,1979.
4. Advanced Electronics Communications Systems by Wayne Tomasi, 6th Edition, Prentice Hall,1998.

(Elective Foundation)

PHY-104(C)	Computer Architecture and Networking	L-5,T-1,P-0	4Credits

Pre-requisite: Understanding of graduate level Basic Physics and Electronics

Course Objectives: The aim and objective of the course on Computer Architecture and Networking for the students of M.Sc. Physics is to equip them with the knowledge of Computer architecture and working and also various networking protocols.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand basics of logic circuits and computer functional blocks
CO2	Know machine instructions and assembly languages
CO3	Comprehend I/O organization
CO4	Appreciate differences between different memory devices

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	2	1	1	2	2	3	1	2
CO2	2	2	3	3	2	1	2	2	2	3	1	1
CO3	2	2	3	3	2	1	2	2	2	3	1	3
CO4	2	2	3	3	2	1	2	2	2	3	1	3

PHY104(c):Computer Architecture and Networking

UNIT– I: Logic Circuits

Logic functions – synthesis of logic functions – Minimization of logic - Synthesis with NAND and NOR gates – Implementation of Logic gates – Flip-Flops – Registers and shift registers – counters – decoders – multiplexers – PLDs – sequential circuits. Basic structure of computers: Functional units – Basic operational concepts – Bus structures performance – Multi processors and multi computers.

UNIT–II: Machine Instructions and programs

Numbers, arithmetic operations and characters – memory locations and address, operations – Instructions and instruction sequencing–addressing modes–assembly language–basic

input/output operations–subroutines–encoding of machine instruction. Instructions–assembly languages–O/I operations-registers and addressing–instructions–assembly language –instructionsof68000andIntelPentium.

UNIT–III: Input/output organization

Accessing I/O devices – interrupts – direct memory access – buses 240 interface circuits – standard I/O interface.

UNIT– IV: Memory System

Concepts semiconductor RAM memories – Randomly memories - cache memories performance considerations – virtual memories – memory management requirements – secondary storage arithmetic: addition and subtraction of signed numbers – design of fast adders – multiplication of positive numbers–signed oper and multiplication–fast multiplication–integer division –floating point numbers and operations.

Books for Study

1. Hamacher CV ranesic Z and Zaky S. Computer Organization, 5th Edition, Mc Graw Hill 2002.
2. Stallings W. Computer Organization and Architecture6th Edition, Pearson Education2003
3. Mano MM, Computer System Architecture 3rd Edition Phi 1993
4. Yarbrough J.M. Digital Logic Applications and Design, Thomas Learning1997
5. Heuring VP and Jordan HF Computer Systems Design and Architecture, Pearson Education 1977

(Mandatory Core)

PHY201	**Statistical Mechanics**	**L-5,T-1,P-0**	**4Credits**

Pre-requisite: Understanding of graduate level statistical mechanics

Course Objectives: The aim and objective of the course on **Statistical Mechanics** is to equip the M.Sc. student with the techniques of statistical ensemble theory so that he/she can use these to understand the macroscopic properties of the matter in bulk in terms of its microscopic constituents.

Course Outcomes: At the end of the course, the student will be able to

CO1	Use ensemble theory to explain the behavior of Physical systems
CO2	Understanding
CO3	Explain the statistical behavior of Bose-Einstein and their applications.
CO4	Fermi –Dirac Statistics & Fluctuations

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	-	-	-	-	-	1	1	-	-	-
CO2	3	3	3	1	3	2	1	2	2	1	1	1
CO3	3	3	3	1	2	2	1	2	2	1	1	1
CO4	3	3	3	1	2	2	1	2	2	1	1	1

PHY201: Statistical Mechanics

UNIT-I: Ensembles

Phase space – Concept of ensembles – Types of ensembles - Ensemble average -Liouville's Theorem – Microcanonical ensemble: ideal gas – Gibb's paradox and its resolution – Entropy and probability – Canonical ensemble – Ideal gas in canonical ensemble –Grand canonical ensemble–Ideal gas in grand canonical ensemble– Comparison of various ensembles.

UNIT–II: Partition Functions

Canonical partition function – Molecular partition function – Transnational partition function – Rotational partition function – Vibrational partition function – Electronic and Nuclear partition

functions – Applications of Rotational partition function – Applications of vibrational partition function to solids

UNIT–III: Maxwell –Boltzmann and Bose –Einstein Statistics

Maxwell-Boltzmann distribution- Distribution of velocities–Experimental verification- Calculation of mean values–Equipartition energy- Bose–Einstein distribution, Bose–Einstein condensation, Black body radiation and the Planck's radiation law - Dulong and Petit's law - Einstein and Debye's theories of heat capacities - Liquid helium – Two fluid model of liquid helium II– Super fluid phase of ^{3}He.

UNIT–IV: Fermi –Dirac Statistics & Fluctuations

Fermi - Dirac distribution – Electrons in metals – Thermionic emission – Magnetic susceptibility of free electrons – White dwarfs – Fluctuations in ensembles, On sagar's one dimensional and reciprocal rotations and their applications to thermos electric phenomena, Kelvin's first and second equations: One dimensional random walk–Random walk and Brownian motion.

Books for Study

1. Statistical Mechanics by B.K. Agarwal, Melvin Eisner- Publisher John Wiley & Sons,1988
2. Statistical Mechanics and properties of Matter by ESR Gopal–Publishers Ellis Horwood, 1974
3. Statistical and Thermal Physics by F. Reif-Publisher WavelandPress,2009
4. Elementary Statistical Mechanics by C.Kittel-Dover Publications, 2012
5. Statistical Physics by Bhattacharjee, Allied Publishers Limited,2000
6. Thermal Physics by Kittel and Kremer –W.H. Freeman and Company, 1980

(Mandatory Core)

PHY- 202	Electromagnetic Theory, Lasers and Modern Optics	L-3,T-1,P-2	4Credits

Pre-requisite: Understanding of graduate level optics and Lasers

Course Objectives: Course Objectives: The aim and objective of the course on Electromagnetic Theory, Lasers and Modern Optics is to expose the M.Sc. students to the basics of the challenging research field of optical fibres and their use in nonlinear optics.

Course Outcomes : At the end of the course, the student will be able to

CO1	Understand the electro statistics and magneto statistics and also the properties of propagation of electromagnetic radiation in different media
CO2	Know about the properties of laser beam and the working of different lasers and applications
CO3	Describe the fourier analysis in optics problems and to understand the concept of holography
CO4	Analyze the propagation of light in optical fibers and to know the various applications of optical fibers

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	1	-	1	-	1	-	3	-	1
CO2	3	2	1	1	1	1	-	1	-	3	-	1
CO3	2	2	-	1	-	1	-	1	-	3	-	1
CO4	3	2	1	1	1	-	-	1	-	3	-	1

PHY202: Electromagnetic Theory, Lasers and Modern Optics

UNIT– I: Electromagnetic Theory

Electromagnetic radiation; Introduction to electrostatics and magnetostatics–Electro dynamics: emf – electromagnetic induction – Maxwell's equations in differential and integral forms- Retarded potentials – Radiation from moving point charge and oscillating dipoles –Linear antenna–Radiation resistance –electric quadrupole radiation - Lienard –Wiechert potentials.

General wave equation – Propagation of light in isotropic dielectric medium – Dispersion – Propagation of light in conducting medium- skin depth–Reflection and refraction at the boundary of a dielectric interface– Fresnel's equations– Propagation of light in crystals-Double refraction.

UNIT–II: Lasers and Non-Linear Optics

Introduction to lasers – Spontaneous and stimulated emission – Laser beam properties – Einstein coefficients – Population inversion – Pumping schemes – Losses in laser radiation – Threshold condition for laser oscillation – Laser cavity - Q factor– different experimental methods – Rubylaser- Ga Aslaser -He-Nelaser–Argon ionlaser– CO_2laser–Laser applications.

Basic Principles – Origin of optical nonlinearity - Harmonic generation – Second harmonic generation–Phase matching condition–Third harmonic generation–Optical mixing–Parametric generation of light – Parametric light oscillator – Frequency up conversion – Self focusing of

light -Guided wave optics-Pulse compression -Optical solutions.

UNIT–III: Holography and Fourier Optics

Introduction to Holography – Basic theory of Holography – Recording and reconstruction of Hologram–Diffuse object illumination– Speckle pattern–Frene land Fourier transform Holography– Applications of Holography.

Introduction to Fourier optics – Two dimensional Fourier transforms – Transforms of Dirac-delta function – The convolution integral – convolution theorem- Spectra and correlation – Parsevel's formula–Apodization–Array theorem– Fourier methods in diffraction- Fraunhouffer diffraction of single slit, double slit and transmission grating using Fourier method.

UNIT–IV: Fiber Optics

Total internal reflection - Optical fiber modes and configuration – Single mode fibers – Graded index fiber structure – Fiber materials and fabrication – Mechanical properties of fibers – Fiberoptic cables – Attenuation – Signal distortion on optical wave guides - Erbium doped fiber amplifiers – Solitons in optical fibers - Block diagram of fiber optic communication system - Applications of optical fibers in communication and medicine.

Books for Study

1. Introduction to Electro dynamics, D.J. Griffiths, Prentice-Hall, India, 2015
2. Electromagnetics, B.B. Laud, Wiley-Eastern, New Delhi, 2011
3. Introduction to Modern Optics, G.R. Fowels,2012
4. Lasers and their Applications, M.J. Beesly, Taylor andFrancis,1976
5. Lasers and Non-Linear Optics, B.B. Laud, Wiley Eastern Ltd.,1983
6. Optics, E.Hecht, Addison Wiley,1974
7. Optical Fiber Communications, G. Keiser, Mc Graw HillBook, 2000

(Compulsory Foundation)

PHY-203(a)	Nuclear Physics	L-5,T-1,P-0	4Credits

Pre-requisite: Understanding of graduate level physics

Course Objectives: The aim and objective of the course on **Nuclear Physics** is to familiarize the students of M.Sc. class to the basic aspects of Nuclear Physics like static properties of nuclei, radioactive decays, nuclear forces, nuclear models, and nuclear reactions so that they are equipped with the techniques used in studying these things.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the basics of nuclear forces and their characteristics and also about various nuclear models
CO2	Know the various types of nuclear reactions and nuclear decay system
CO3	Understand the basic principles in nuclear accelerators and rectors and also their applications
CO4	Describe the various elementary particles and their conservation layers.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	2	1	1	2	1	2	2	2
CO2	3	3	1	1	2	1	1	2	1	2	2	2
CO3	3	3	1	1	2	1	1	2	1	2	2	2
CO4	3	3	1	1	2	1	1	2	1	2	2	2

PHY203 (a): Nuclear Physics

UNIT– I: Nuclear Forces and Models

Nuclear Forces: Characteristics of nuclear forces –Ground state of Deuteron–Proton–Proton scattering–Neutron – Proton scattering–Meson theory of nuclear forces.

Nuclear Models: Introduction–The liquid drop model–Bethe-Weizacker semi-empirical binding energy equation and its applications – Nuclear shell model – Energy levels and calculation of angular momentum– Collective model.

UNIT–II: Nuclear Reactions and Decays

Nuclear Reactions: Types of nuclear reactions–Compound nuclear reactions–Nuclear cross section–Resonance theory– Briet Wigner formula.

Nuclear Decays: Nuclear transformations–Radioactivedecay–Alphadecay–Gamow'stheory–Betadecay–Fermi theory–Selection rules – Interaction of gamma radiation with matter–Photo electric effect –Compton scattering–Pair production.

UNIT–III: Nuclear Accelerators and Reactors

Nuclear Accelerators: Introduction – Linear accelerators – Drift tube and Wave guide accelerators –Low energy circular accelerators–Cyclotron and Betatron–High energy circular accelerators–Synchrotron and Microtron.

Nuclear Reactors: Nuclear fission and fusion reactions – Nuclear chain reactions – Four factor formula – The critical size of a reactor – General aspects of reactor design – Classification of reactors – Power reactors (elementary aspects only).

UNIT–IV: **Elementary Particles**

Discovery and classification of elementary particles–Types of interactions –Conservation laws–Iso-spin, parity, charge conjugation – Time reversal – CPT theorem – Properties of leptons, mesons andbaryons – Elementary particle symmetries (SU_2 and SU_3 symmetries) – Quark model – Search for Higg's particle – elementary ideas.

Book for Study

1. Nuclear Physics, Irving Kaplan, Narosa Pub. (1998).
2. Nuclear Physics, Theory and experiment–P.R. Roy and B.P. Nigam, New Age Int.1997.
3. Atomic and Nuclear Physics (Vol.2), S.N. Ghoshal, S. Chand & Co.(1994).
4. Nuclear Physics, D.C. Tayal, Himalaya Pub.(1997).
5. Atomic and Nuclear Physics, R.C. Sharma, K. Nath & Co., Meerut(2007).
6. Nuclei and Particles, E.Segre, WA Benjamin. Inc., (1965).
7. Introduction to Nuclear Physics, H.A. Enge, Addison Wesley(1975).
8. Introduction to Nuclear Physics, K.S. Krane, John Wiley & Sons(1988).

(Compulsory Foundation)

PHY-203(b)	IC fabrication Techniques	L-5,T-1,P-0	4Credits

Pre-requisite: Understanding of graduate level physics

Course Objectives: The aim and objective of the course on **IC fabrication Techniques** is to familiarize the students of M.Sc. class to the basic aspects of IC fabrication, different techniques in preparing and processing of IC technology and deposition techniques.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand and compare crystal growth and Epitaxial deposition techniques
CO2	Understand structure and process of oxidation
CO3	Study the diffusion processes
CO4	Understand vacuum deposition techniques

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	2	1	1	2	1	2	2	2
CO2	3	3	1	1	2	1	1	2	1	2	2	2
CO3	3	3	1	1	2	1	1	2	1	2	2	2
CO4	3	3	1	1	2	1	1	2	1	2	2	2

PHY 203 (b): IC Fabrication Techniques

UNIT– I: IC Fabrication Technology

Wafer preparation: Silicon crystal growth, Wafer orientation, Sawing and polishing, Crystal orientation, Doping of crystals during growth.

Epitaxial deposition: Introduction theory, Growth of an Epitaxial layer, evaluation of Epitaxial layers.

UNIT– II: Oxidation

Introduction, equipment for thermal oxidation, oxidation process, oxide evaluation, recent advances in oxidation technology, oxide thickness determination, oxidation function, redistribution of dopant atoms during thermal oxidation, anodic oxidation.

UNIT-III: Impurity

Introduction and redistribution, the idea of diffusion, diffusion process, diffusion analysis, ion implementation,

UNIT–IV: Photomasking

Introduction – generation of photomask. Metallization: Metallization of requirements, vacuum deposition, deposition techniques, vacuum deposition cycle.

Books for Study

1. Instrumentation Measurement and Analysis by Nakra and Choudary, 4th Edition, Tata Mc Graw-Hill, 1985.
2. Instrumentation–Devices and Systems by Rangan, Sarma and Mani, 2nd Edition, Tata Mc Graw-Hill, 1997.
3. Measurement of Systems Applications and Design by Earnest O.Doeblin, 7th Edition, Mc Graw-Hill,1990.
4. A course in Electrical; and Electronic Measurements and Instrumentation by A.K. Sawhney, 3rd Edition, Dhanpat Rai &Company, 2016.
5. Electronic Instrumentation and Measurements Techniques, Cooperand Albert D.Helfriek, 3rd Edition, Pearson India Education, 2016.
6. Applied Electronics by G.K. Mithal, 20th Edition, Khanna Publishers, 1997.
7. Principles of Industrial Instrumentation by D.Patranabis,Tata Mc Graw-Hill,1976.

(CompulsoryFoundation)

PHY-203(c)	Advanced Microprocessors and Its Applications	L-3,T-1,P-2	4Credits

Pre-requisite: Understanding of graduate level physics

Course Objectives: **The aim and objective of the course on Advanced Microprocessors and Its Applications** is to familiarize the students of M.Sc. class to the basic aspects of micro processors and different programming and interfacing techniques.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understanding of microprocessor architecture and evaluation
CO2	Develop skill of writing programs in ALP for various applications of 8085 & 8051
CO3	Interface various peripherals with 8085 & 8051.
CO4	Understanding interrupts and direct memory access

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	2	1	1	2	1	2	2	2
CO2	3	3	1	1	2	1	1	2	1	2	2	2
CO3	3	3	1	1	2	1	1	2	1	2	2	2
CO4	3	3	1	1	2	1	1	2	1	2	2	2

PHY203(c): Advanced Micro processors and Its Applications

UNIT–I: Microprocessors and its Architecture

Internal microprocessor architecture, Real mode and protected modes of memory addressing, Memory paging.

Addressing modes-Data addressing modes, program memory – addressing modes, Stack - memory addressing modes.
Instruction Set - Data movement instruction, Arithmetic and logic Instruction, Program control instructions, Assembler details.

UNIT–II: Programming the Micro processor

Modular programming, using the keyboard and video display, Data conversions.
Hardware Specifications - Pin - outs and the pin functions, clock - generator (8284A), Bus buffering and latching, Bus timing, Ready and Wait state, Minimum mode versus maximum

mode.

UNIT–III: Memory Interface

Memory devices, Address decoding,8088and80188 (8-bit) memory interface, 8086,80186, 80286and 80386 (16-bit) memory interface.

Basic I/O Interface - Introducing to I/interface, I/O port address decoding, 8255,8279, 8254, ADC and DAC (excluding multiplexed display& keyboard displayusing8255).

UNIT–IV: Interrupts

Basic interrupt processing, Hardware interrupts, expanding the interrupt structure,8259APIC.
Direct Memory Access-Basic DMA operation, 8237DMAcontroller.
Bus Interface -PCI bus.

Book for Study

1. B.B. Brey, "The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium and Pentium pro processor architecture, programming and interfacing", 4/e, PHI,1999.
2. K.J. Ayala, "The 8086 Microprocessor: Programming & Interfacing the PC" Penram International Publishing (India) Pvt. Ltd., 1995.
3. Douglas V.Hall, "Microprocessors and Interfacing, Programming and Hardware",2/e, Mc Graw Hill, International Edition, 1992.
4. Muhammad Ali Mazidi and Janice Gillispie Mazidi, "The 80x86 IBMPC and Compatible Computers, (VolumesI &II)". 2/e, Printice– Hall, Inc., 1998.
5. Walter A.Triebe land Avatar Singh, "Software, Hardware and Applications"PHI,1995.
6. Yu Cheng Lin and Glenn A. Gibson, "Micro computer systems: The 8086/8088 Family Architecture, Programming and Design", PHI,1992.

(ElectiveFoundation)

PHY204(a)	**Mathematical Physics**	**L-5,T-1,P-0**	**4Credits**

Pre-requisite: Understanding of graduate level mathematics

Course Objectives: The aim and objective of the course on **Mathematical Physics** is to equip the M.Sc. Students with the mathematical techniques that he/she needs for understanding theoretical treatment in different courses taught in this class and for developing a strong background if he/she chooses to pursue research in physics as a career.

Course Outcomes: At the end of the course, the student will able to

CO1	Understand the basics and applications of special functions in all the branches of Physics.
CO2	Use Fourier series and transformations as an aid for analyzing physical problems.
CO3	Apply integral transform to solve mathematical problems of Physics interest.
CO4	Formulate and express a physical law in terms of complex variables and simplify it by use of coordinate transforms.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	1	1	-	2	1	1	2
CO2	3	3	2	2	-	1	1	-	2	1	1	2
CO3	3	3	2	2	-	1	1	-	2	1	1	2
CO4	3	3	2	2	-	1	1	-	2	1	1	2

PHY204(a): Mathematical Physics

UNIT-I: Special Functions

Beta and Gamma Functions – Definitions and properties – Evaluation of integrals, Legendre, Bessel and Hermite differential equations– Solutions– Generating functions– Orthogonal properties of Legendre, Bessel and Hermite Functions (Proof not necessary)–Recurrence relations– (Proof for Legendre polynomials only).

UNIT-II: Integral Transforms

Fourier Transforms: Properties of Fourier transforms – Fourier sine and cosine transforms-Power in Fourier series **–** Modulation theorem, Fourier transform of impulse function, Constants, Unit step function and Periodic functions.

Laplace Transforms: Definition and notation – Properties of Laplace transforms – Laplace transforms of Dirac delta function and periodic functions (Square wave, sawtooth wave and triangular wave) –Inverse Laplace transforms– properties– Solution of linear differential equations with constant coefficients - Applications to LCR circuits and resonance of simple pendulum.

(ElectiveFoundation)

UNIT-III: Numerical Techniques

Solution of an equation – Bisection method, Regular False method, Newton – Rhapson method Solutions of simultaneous– Gauss elimination method and Gauss-Seidel method–Interpolations - Newton's interpolation and Lagrange's interpolation, Curve fitting – Method of Least squares. Numerical differentiation and integration – Trapezoidal rule and Simpson's 1/3 rule – Solutions of differential equations– Euler's method and Runga-kutta Methods.

UNIT–IV: Complex Variables

Functions– Complex differentiation- Analytic function-Cauchy–Riemann equations –Derivatives of elementary functions – Singular points and classification. Complex integration - Cauchy's theorem – Integrals of special functions – Cauchy's integral formula – Taylor's and Lorentz theorem (statements only) – Residues, calculations of residues - Residue theorem – evaluation of definite integrals.

Books for Study

1. Mathematical physics, B.D. Gupta,4th edition, Vikas publishing house,2010
2. Mathematical physics, B.S. Rajput, Pragati Prakashan Meerut, 2017
3. Special Functions for Scientists and Engineers, W.W. Bell, DoverPublications,2013
4. Laplace Transforms, Murray Spiegle, Schaum's outlineseries, Mc Graw Hill, International Book Company, NY, 2005
5. Applied Mathematics for Engineers, Louis A. Pipes, Lawrence R. Harvill, Courier Corporation, 2014
6. Theory and Properties of Complex Variables, Schaum's outlineseries, Murray R. Spiegel, Seymour Lipschutz, John J. Schiller, Dennis Spellman, Mc Graw-Hill, 1976
7. Complex Variables and Applications, Brown and Churchill, Mc Graw–Hill,2013
8. Applied Fourier analysis, Hweipiao Hsu, UnitechDivision,1984
9. An Introduction to Mathematical Physics, Suresh Chandra, Mohit Kumar Sarma Alpha Science International, 2013.

(Elective Foundation)

PHY204(b)	**Introduction to VLSI design**	**L-5,T-1,P-0**	**4Credits**

Pre-requisite: Understanding of graduate level mathematics

Course Objectives: The aim and objective of the course on is to equip the M.Sc. Students with the **Introduction to VLSI design** that he/she needs for understanding theoretical treatment in different courses taught in this class and for developing a strong background if he/she chooses to pursue research in physics as a career.

Course Outcomes: At the end of the course, the student will able to

CO1	Demonstrate a clear understanding of CMOS fabrication flow and technology scaling.
CO2	Analyze CMOS based logic circuit
CO3	Realize logic circuits with different design styles
CO4	Understand Front & Back end design aspects of simple VLSI Digital circuits

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	1	1	-	2	1	1	2
CO2	3	3	2	2	-	1	1	-	2	1	1	2
CO3	3	3	2	2	-	1	1	-	2	1	1	2
CO4	3	3	2	2	-	1	1	-	2	1	1	2

PHY 204 (b): Introduction to VLSI Design

UNIT-I: **An Overview of VLSI and Logic Design with MOSFET**

Complexity and Design, Basic concepts, Ideal switches and Boolean operations, MOSFETs as switches, Basic logics gates in CMOS, Complex logic gates in CMOS, Transmission Gate circuits, Clocking and data flow control.

UNIT-II: Physical Structure and Fabrication of CMOS ICs

Integrated Circuit layers, MOSFETs, CMOS layers, Designing FET arrays, Overview of silicon processing, Material growth and deposition, Lithography, The CMOS process flow, Design rules.

UNIT-III: **Elements of Physical Design and Electrical Characteristics of MOSFETs**

Basic concepts, Layout of basic structures, Cell concepts, FET sizing and the unit transistor,

Physical design of logic gates, Design hierarchies, MOS physics, nFET current-voltage equations, FET RC model, pFET characteristics, Modeling of small MOSFETs.

UNIT-IV: **Electronic analysis of CMOS logic gates**

DC characteristics of the CMOS inverter, Inverter switching characteristics, Power dissipation, DC characteristics: NAND and NOR gates, NAND and NOR transient response, Analysis of complex logic gates, Gate design for transient performance, Transmission gates and pass transistors.

Designing High-speed CMOS Logic Networks- Gate delays, Driving Large capacitive loads, Logical effort, Bi CMOS drivers.

Book for Study

1. John P. Uyemura, "Introduction to VLSI circuits and Systems", John Wiley & Sons Asia)Pet Ltd., 2003.
2. S.K. Ghandhi,"VLSI Fabrication principles",2/e, John Wiley & Sons(Asia)Pte. Ltd., 2003.
3. S.M. Sze, "VLSI Technology",2/e, Mc Graw-Hill, 1988.
4. N.H.E. Weste and K. Eshraghian, "Principles of CMOSVLSI design", Pearson Education, Inc., 1999.
5. Yuan Taur and T.H. Ning, "Fundamentals of Modern VLSI devices", Cambridge University, Press, 1998.
6. R.L. Geiger, P.E.Allen and N.R.Strader,"VLSI design Techniques for Analog and Digital Circuits", Mc Graw-Hill, 1990.

(Elective Foundation)

PHY -204 (c)	Materials Science for Industrial Applications	L-5,T-1,P-0	4Credits

Pre-requisite: Course on Particle Physics

Course Objectives: The aim and objective of the course on Materials Science for Industrial Applications is to expose the students of M.Sc. students to experimental aspects of different equipment and methods used in the fields of Industrial applications

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand various experimental techniques for describing interaction of organic materials
CO2	Use error analysis for experimental data.
CO3	Knowledge about the different types of the Liquid crystals
CO4	Apply the knowledge of phase transformations for various applications

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	2	-	1	-	-	1	-	1	1	1
CO2	-	-	-	3	-	-	-	3	1	1	1	1
CO3	-	-	1	2	3	-	1	3	2	2	2	2
CO4	-	-	1	3	3	1	1	2	2	2	2	2

PHY 204 (c): Materials Science for Industrial Applications

UNIT– I: Organic materials and their properties

Introduction - polymerization mechanism. Structure and properties of polymers. Strengthening of polymers. Behavior of polymers. Deformation of polymers and their industrial use. Ceramic Materials: Introduction– Classification of ceramic. Structure of ceramics. Polymorphism. Properties of ceramic and their applications.

UNIT–II: Liquid Crystals

Introduction–classification, oriental order, Elasticity, magnetic effects, optical properties – applications.
Ferroelectrics: General properties of ferro electric materials. Theories of ferroelectricity. Thermo dynamic of Ferro electric transitions. Magnetic Materials: Classification. The domain structure. Soft and hard magnetic materials, Ferrites, ceramic magnets.

UNIT–III: Phase diagrams and phase transformation

The Phase rules. Unary and binary phase diagrams. Typical phase diagrams- coper-zinc systems. Iron-carbon system. Other applications of phase diagrams. Phase transformation. Nucleation and growth. Nucleation kinetics. Martensic transformation.

UNIT–IV: Thin films

Theories of thin film nucleation and growth. Thin film preparation – Rf sputtering. Chemical vapor deposition. Thickens measurements. Electrical and optical properties of thin films Applications.
Super conductivity: Messier Effect. The critical field. Theories of super conductivity. Tunneling and Josephson effect. High Tc super conductors. Application of super conductors.

Books for Study

1. Introduction to Solid State Physics, Charles Kittel VII edition, John Wiley & Sons.
2. Solid State Physics, A.J. Dekker, Mc Millan Publications.
3. Solid State Physics, M.A. Wahab, Narosa Publishing House.
4. Fundamentals of Solid State Physics, Saxena, Gupta, Saxena, Pragathi Publications, Meerut.
5. Solid State Physics, R.L. Singhal, Kedar Nath Ram Nath & Co.Pub.
6. Science of Engineering Materials, C.M. Srivastsava and C.Srinivasan, New Age Inter. Pub.
7. Crystal Growth, B.R. Pamplin, Pergmon Press.
8. Crystal Growth from High Temperature Solutions, D. Elwell and H.J. Scheel, Academic Press.

(MandatoryCore)

PHY-301	Introductory Quantum Mechanics	L-5,T-1,P-0	4Credits

Pre-requisite: Basic knowledge of wave mechanical quantum Mechanics

Course Objectives: The aim and objective of the course on **Introductory Quantum Mechanics** is to introduce the students of M.Sc. class to the formal structure of the subject and to equip them with the techniques of vector spaces, angular momentum, perturbation theory, and scattering theory so that they can use these in various branches of physics as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the need for quantum mechanical formalism and its basic principles.
CO2	Appreciate the importance and implication of vector spaces, Dirac Ket Bra notations, eigen value problem.
CO3	Understand the need of approximate methods in solving problems
CO4	Understanding scattering theory and its importance.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	2	1	1	2	3	2	2
CO2	3	2	2	2	2	2	1	1	2	2	2	2
CO3	3	2	2	2	2	2	1	2	1	3	2	2
CO4	3	2	2	2	2	2	2	2	2	2	2	2

PHY 301: Introductory Quantum Mechanics

UNIT-I: Formulation and Simple Problems

Wave particle duality – Wave functions in coordinate and momentum representation- Postulates of quantum mechanics -Linear vector space: Hilbert space - Dirac's Bra and Ket notations- Hermitian operators and their properties-Matrix representation of an operator-Unitary operators- Unitary transformation - The Kronicker Delta and Dirac delta functions- Eigen values and Eigen functions for finite potential well and step barrier–Quantum mechanical tunneling.

UNIT-II: Quantum Dynamics and Simple Problems

Equations of motion - Schrodinger Picture- Heisenberg Picture- Interaction Picture- EquivalenceofvariousPictures-PoissonandCommutationbrackets-TheirProperties- EigenvaluesandEigenfunctionsforSimpleharmonicoscillator-Polynomial method and abstract operator method in one dimension- Eigen values and Eigen functions for a free particle and particle in a box in three dimensions.

(MandatoryCore)

UNIT-III: Approximate Methods

Time independent perturbation theory for non-degenerate levels: Perturbed harmonic oscillator, Normal Helium atom, Stark effect of the plane rotator. First order perturbation theory for degenerate levels: First order Stark effecting in hydrogen atom; Time dependent perturbation theory: Transition to continuum (Fermi Golden rule).
WKB approximation – Turning points and connecting formulae: Application to potential barrier. Variational methods.

UNIT-IV: Scattering Theory

Introduction: classical theory of scattering - Quantum theory of scattering - Method of partial wave analysis- Scattering by a perfectly rigid sphere- Greens function in scattering theory -Born approximation-Validity of Born approximation-optical theorem.

Books for Study

1. Quantum Mechanics: Concepts and Applications by Nouredine Zettili, Wiley, Ed.,2021
2. Introduction to Quantum Mechanics by David J.Griffiths and Darrell F.Schoeter, Third Ed., Cambridge University Press India PvtLtd.,2018.
3. Quantum Mechanics: G. Arul das PHI learning private limited Second edition, 2018
4. Quantum Mechanics: S.L. Kakani and H.M. Chandalia Sultan Chand and, Sons First Edition, 2004
5. Advanced Quantum Mechanics: B.S. Rajput, Pragati prakasan,2019
6. Quantum Mechanics: V.K. Thankappan, New Age International(P)Ltd., Publishers,1993
7. A Textbook of Quantum Mechanics: P.M. Mathews and K.Venkatesan, Tata Mc Graw Hill Publishing Company, 2008
8. Quantum Mechanics: S.L. Gupta, V. Kumar, H.V. Sharma and R.C. Sharma, Jai Prakash Nath and Company, 2007
9. An Introduction to Quantum Mechanics, P.T. Mathews Mc Graw Hill Publishing Company, 1974

(MandatoryCore)

PHY -302	Physics of Semiconductor devices	L-5,T-1,P-0	4Credits

Pre-requisite: Course on general Physics

Course Objectives: The aim and objective of the course on **Physics of Semiconductor devices** is to expose the students of M.Sc. students to experimental aspects of different semiconductor devise technologies, characterization and fabrication.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand various experimental techniques for semiconductor junctions and interfaces
CO2	Use I-V characteristics to understand the function of devices
CO3	Apply the knowledge of Junction transistors for various applications
CO4	To get familiarization with Power Devices and Semiconductor Technology

Mapping of course out comes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	2	-	1	-	-	1	-	1	1	1
CO2	-	-	-	3	-	-	-	3	1	1	1	1
CO3	-	-	1	2	3	-	1	3	2	2	2	2
CO4	-	-	1	3	3	1	1	2	2	2	2	2

PHY302: Physics of Semiconductor Devices

UNIT-I: Junctions and Interfaces

p-n Junctions: Descriptionofp-nJunctionaction–Junctioninequilibrium-applicationofbias–energy band diagrams. Abrupt junction – calculation of the built-in Voltage- electric field and potential distributions – Expression for Depletion layer capacitance, Static I-V characteristics of p-n junction diodes: Ideal diode model- Derivation of ideal diode equation. Real diodes – Carrier generation – recombination in the junction depletion region, I-V characteristics of Real Diodes.
Electrical breakdown inp-njunctions: Zener and Avalanche breakdown inp-njunctions, Distinction between the Zener and Avalanche breakdown.

UNIT-II: Junction Diodes

Majority carrier diodes: Tunnel diode- I-V characteristics, equivalent circuits as an oscillator and amplifier. Backward diode, Schottky barrier diode-operation and applications.
Microwave devices: Varactor diode- basic principle, equivalent circuit, Figure of merit and applications.p-i-ndiodeoperationanditsapplications.Transferred-electrondevices-Gunneffect devices- domain formation- modes of operation. Avalanche Transit devices: IMPATT diode,

TRAPATT diode, BARITT diode.

UNIT-III: Junction Transistors

Bipolar junction transistors: Principle of operation- Analysis of the ideal diffusion transistor – Calculation of terminal currents, DC parameters. Ebers- Moll Equations–Four regions of operation of a bipolar transistor. Real transistors -- carrier recombination in the Emitter-Base junction depletion region – Effect of collector bias variation, avalanche multiplication in the collector – base junction and base resistance. Basic Structures and the operating principle of MOSFET, I-V characteristics of an ideal MOSFET, Charge Coupled Devices (CCD)-principle of operation.

UNIT–IV: Power Devices and Semiconductor Technology

Power rectifiers and Thyristors: Power rectifiers, Thyristors, Some special thyristor structures, Bidirectional thyristors, Field-controlled thyristor. Technology of Semiconductor Devices: Crystal growth and Wafer preparation, Methods of p-njunction formation, Growth and deposition of dielectric layers, Planar technology, Masking and lithography, Pattern definition, Metal deposition techniques.

Books for Study

1. Introduction to Semiconductor Materials and Devices by M.S. Tyagi, John Wiley & Sons (Asia) Pte. Ltd., Singapore, 2000.
2. Microwave Devices and circuits by SAMUELY. LIAO, Prentice-Hall of India,1999.
3. Microwave and Radar Engineering by M. Kulkarni, UMESH publications, New Delhi,1999.
4. Physics of Semiconductor Devices by S.M.Sze, 3rdEdition, Oct.2006,JohnWiley
5. Solid State Electronic Devices by B.G. Streetman, PHI, New Delhi, 2006

(GenericElective)

PHY-303 (a)	Applied Spectroscopy	L-3,T-1,P-2	4 Credits

Pre-requisite: Understanding of graduate level spectroscopy

Course Objectives: The aim and objective of the course on Applied Spectroscopy
For the students of M.Sc. Physics is to equip them with the knowledge of Atomic, Rotational, Vibrational, Raman, and Electronic spectra.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the rotational and vibrational spectra of di molecules and their applications in structure determinations.
CO2	Know the Raman effect and its use in the structural analysis of various molecules.
CO3	Have the knowledge about various spectrophotometer and the functioning of various parts in SPECTRO PHOTOMETER.
CO4	Understand the basic concepts of fluorescence and phosphorescence their applications in different fields

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	2	1	1	2	2	3	1	2
CO2	2	2	3	3	2	1	2	2	2	3	1	1
CO3	2	2	3	3	2	1	2	2	2	3	1	3
CO4	2	2	3	3	2	1	2	2	2	3	1	3

PHY303(a): Applied Spectroscopy

UNIT-I: Molecular Spectroscopy

Introduction – Rotational and vibrational structure of electronic bands of diatomic molecules – Fortrat diagram – General relations – Combination relations for $^1\Sigma$- $^1\Sigma$ and $^1\Sigma$ – $^1\pi$ bands – Evaluation of rotational constants with reference to above transitions. Isotope effect in electronic spectra of diatomic molecules – Vibrational effect and rotational effect. Potential energy curves - Dissociation energy and pre-dissociation energy - Vibrations of polyatomic molecules: CO_2 and H_2O.

UNIT-II: Raman Spectroscopy

Introduction – Theory of Raman Scattering – Rotational Raman Spectra – Vibrational Raman Spectra–Mutual Exclusion Principle Laser Raman Spectroscopy Sample Handling Techniques – Polarization of Raman Scattered Light – Single Crystal Raman Spectra – Raman Investigation of Phase Transitions – Resonance Raman Scattering – Structure Determination using FTIR and Raman Spectroscopy. Fourier Transform (FT) Raman Spectroscopy and its additional advantages over the conventional Raman Spectroscopy - Surface enhanced Raman Scattering-Coherent Anti-Stokes Raman Spectroscopy.

UNIT–III: Spectro photometry

(GenericElective)

Introduction – Beer's law – Absorptivity – UV and visible absorption –Instrumentation – Essential parts of spectrophotometer – Gratings and prisms – Radiant energy sources – Filters – Photosensitive detectors – Barrier layer cells – Photo emissive cells – Photomultiplier tubes – Relationship between absorption in the visible and UV region and molecular structure – IR Spectrophotometry – Fourier Transform Infrared (FTIR) Spectrometer – Molecular structure – Qualitative and Quantitative analysis–Importance of photography in the spectro chemical analysis.

UNIT-IV: Fluorescence and Phosphorescence Spectroscopy

Introduction – Normal and Resonance Fluorescence – Intensities of Transitions – Non-radiative decay of fluorescent molecules – Phosphorescence and the nature of the triplet state – Population of the tripletstate–DelayedFluorescence–Excitationspectra–Experimentalmethods–Emission life time measurements–Time resolved emission spectroscopy –Applications of Fluorescence and Phosphorescence.

Books for Study

1. Molecular spectra and Molecular Structure Vol. I, G. Herzberg,2nd Ed, Van. Nostr and (1950).
2. Fundamentals of Molecular Spectroscopy, C.N. Banwell, Tata McGraw-Hill,(1983).
3. Spectroscopy Straughan and Walker(Vol.2 &3),John Wiley & Sons, (1976).
4. Molecular Structure and Spectroscopy G. Aruldhas, Printice -Hall Pvt. Ltd.(2001).
5. Instrumental Methods of Analysis Willard, Merritt, Dean & Settle, CBS Pub,(2001).
6. Spectro chemical Analysis, L.H. Ahrens and S.R.Taylor, Addison–Wesley,London,Pergamon,1961.
7. Elements of Spectroscopy, Gupta, Kumar and Sharma Pragati Prakasan, NewDelhi (2012).
8. Elements of Diatomic Molecular Spectra, H.Dunford, Addison Wesly Publishing company,1965.
9. Problems in Spectroscopy, S.V.J.Lakshman,ICSU,Costed,1988.
10. Basic Principles of Spectroscopy by R. Chang, Mic Graw Hill,1971.
11. Principles of Fluorescence Spectroscopy, Joseph R. Lakowicz- Plenum Press, (1983).

(GenericElective)

PHY-303(b)	Condensed Matter Physics	L-3,T-1,P-2	4Credits

Pre-requisite: Understanding of graduate level solid state physics

Course Objectives: The aim and objective of the course on **Condensed Matter Physics** is to expose the students of M.Sc. class to the topics like elastic properties, thermal properties, Fermi surface studies and photoluminescence so that they are equipped with the knowledge on the matter in condensed phase.

Course Outcomes: At the end of the course, the student will be able to

CO1	They gain knowledge on elastic properties of solids and its importance.
CO2	Differentiate they gain knowledge on specific heat and Thermal importance.
CO3	Understand the importance of Fermi surface in electrical properties of Solids.
CO4	Gain knowledge on photoconductivity and its origin

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1	2	1	2	2	2	1	2
CO2	2	2	2	2	2	2	2	2	2	2	2	2
CO3	2	2	1	2	1	2	2	2	1	2	1	2
CO4	2	2	1	2	2	2	1	2	1	2	2	2

PHY303(b): Condensed Matter Physics

UNIT-I: Elastic Properties of Solids

Lattice as a homogeneous and continuous medium - Analysis of stress and strain tensors – Hooke's law - Elastic compliances and stiffness constants– Elastic energy density – Reduction in the number independent elastic constants in cubic crystals–Cauchy's relations–Bulk modulus and compressibility – Elastic waves in cubic crystals – Formulation and solution of wave equations along [100], [110] and [111] directions – Experimental determination of elastic constants – Pulse-echo technique.

UNIT-II: Thermal Properties of Solids

Quantum theory of lattice vibrations – Properties of phonons – Lattice specific heat at low temperatures – Einstein and Debye models – Born cut-off procedure – Inelastic scattering of neutrons by phonons–Experimental study of dispersion curves–Inadequacy of harmonic model – Anharmonicity – Thermal expansion – Gruneisen parameter- Lattice thermal conductivity – Elementary kinetic theory– Role of U and N processes.

UNIT-III: Energy bands and Fermi Surfaces

Energy band calculations: Plane Wave method and Augmented Plane Wave (APW) method.

(GenericElective)

Importance of Fermi surface – Characteristics of Fermi surface – Construction of Fermi surface - Quantization of electron orbits - Experimental study of Fermi surface: Anomalousskin effect – Cyclotron resonance – de Haas van Alphen effect.

UNIT-IV: Photo conductivity and Luminescence

Excitons: Weakly bound and tightly bound – Photoconductivity – Simple model – Influence of traps – Space charge effects – Determination of photoconductivity. Luminescence – Various types–Thermo luminescence, Electroluminescence, Photoluminescence, Cathodoluminescence and Chemiluminescence-Excitation and emission–Decay mechanisms –Applications

Books for Study

1. Solid State Physics, C. Kittel, Edition:8 th 2012, John Wiley & Sons.
2. Solid State Physics, A.J.Dekkar,Edition:1st,2000. Macmillan India Ltd.
3. Solid State Physics, M.A. Wahab, Edition:3rd, 2020, Narosa Publishing House.
4. Fundamentals of Solid State Physics, Saxena, Gupta, Saxena, Edition: 31st, 2019, Pragathi
5. Solid State Physics, R.L. Singhal, Kedar Nath, Ram Nath & Co. Publications, Meerut,2018.

(GenericElective)

PHY-303 (c)	Embedded Systems	L-3,T-1,P-2	4Credits

Pre-requisite: Understanding of graduate level spectroscopy

Course Objectives: The aim and objective of the course on Embedded Systems for the students of M.Sc. Physics is to equip them with the knowledge of microcontrollers and other processors used in the industry.

Course Outcomes: At the end of the course, the student will be able to

CO1	understand about the basic functions and structure of embedded systems
CO2	Get familiarized with Embedded system Design Tools and Hardware
CO3	understand about the basic programming concepts of embedded systems
CO4	know about the applications of PIC microcontrollers

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	2	1	1	2	2	3	1	2
CO2	2	2	3	3	2	1	2	2	2	3	1	1
CO3	2	2	3	3	2	1	2	2	2	3	1	3
CO4	2	2	3	3	2	1	2	2	2	3	1	3

PHY303(c): Embedded Systems

UNIT-I: Introduction to Embedded Systems

Embedded systems in today's world – examples of Embedded systems – Microprocessors and Micro controllers – Microchip and PIC microcontroller – Introduction to PIC micro controllers using the 12 series.
Architecture of 16F84A – Memory organization – in 16F84A – Timing generation – Power-up and Reset functions in 16F84A.

UNIT-II: Hardware Details of 16F84A

Parallel ports: Basic idea – Technical challenge – connecting to the parallel port – Parallel ports of PIC16F84A – Clock oscillator – Power supply – Interrupts – Timers and counters – watch dog timer– Sleep mode.

UNIT-III: Assembler and Assembler Programs

(GenericElective)

Basic idea – PIC 16 series instruction set and ALU – Assemblers and Assembler format – creating simple programs– Adopting a development environment– Building structured programs – Flow control: Branching and Subroutines – Generating time delays and intervals –Logical instruction– Arithmetic instructions.

UNIT-IV: PIC Microcontroller PIC16F873A

Block diagram and CPU– Memory and memory maps–Interrupts–Oscillator, Reset and Power supply– Parallel ports.PIC16F87XATimer0andTimer1–16F87XATimer2, Comparator and PR2 register–capture/Compare/PWM(CCP) Module–Pulse width modulation–ADC module.
Interface: LED displays– Liquid crystal displays–Sensors–Actuators.

Books for Study

1. Designing Embedded Systems with PIC Micro controllers: Principles and Applications by Tim Wilmshurst, First Edition, 2007, Newnes– Elsevier– Publishers.
2. Micro controllers: Theory and Applications by Ajay V. Deshmukh, Tata McGraw-Hill, New Delhi, 2005.
3. Designing with PIC Microcontrollers by JohnB. Peatman, Pearson Education,Inc.,1998.
4. The 8051 Micro controller and Embedded systems, by Mahammad Ali Mazidi and Janice Gillispie Mazidi, Pearson Education Asia, Pvt.Ltd.,2000.

(Skill Oriented Course)

PHY – 305	Advances in Physics	L-3,T-1,P-2	4Credits

Pre-requisite: Understanding of graduate level physics

Course Objectives: The aim and objective of the course on **Advances Physics** for the students of M.Sc. Physics is to equip them with the knowledge of Nano technology, MEMS and remote sensing.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the concepts of nanotechnology
CO2	Physical and chemical techniques of nanomaterial synthesis
CO3	Concepts of Nano materials and Nano devices
CO4	Basics of remote sensing and understanding the concepts of Geographical Information system

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	2	1	1	2	2	3	1	2
CO2	2	2	3	3	2	1	2	2	2	3	1	1
CO3	2	2	3	3	2	1	2	2	2	3	1	3
CO4	2	2	3	3	2	1	2	2	2	3	1	3

PHY305: Advances in Physics

UNIT–I: Nano Technology

Introduction to Nanomaterials– Zero, One- and Two-Dimensional Nanostructures-Quantum confinement-Density of states and Dependence of dimensionality–Properties of Nanomaterials –Carbon Nanotubes, Fullerenes, Graphene.

Synthesis of Nanomaterials–Physical Techniques: Ball Milling–Plasma Arc Deposition–Inert Gas Condensation –Pulsed Laser Deposition– Molecular Beam Epitaxy.

Chemical Techniques: Hydro thermal synthesis– Sol-Gel Process–Chemical Vapor Deposition.

Applications: Single Electron Transistor – Solar Cells–Light Emitting Diodes.

UNIT–II: Micro and Nano devices

Micro electro mechanical systems (MEMS): Introduction to MEMS, Basic MEM structure.

Applications of MEMS: Pressure sensors, Accelerometers Mass flow sensors.

Nanodevices: Quantum well and quantum dot devices: Infrared Detectors-Quantum Dot Lasers.

Carbon nano tube emitters-Photoelectrical cells - Plasmons propagation in wave guides.

UNIT–III: 8051 Micro controllers

Introduction of Microprocessors and Micro controllers, Micro controller: 8051 Internal

Architecture, Register Structure, I/O pins, Memory Organization, 8051 Addressing modes. 8051 Assembly Language Programming Tools. 8051 Instruction set: Data Transfer Instructions, Arithmetic instructions, Logical instructions, Boolean Variable Manipulation Instructions-Bit Addressability, Single-Bit instructions, Program Branching Instructions-Jump, Loop, and Call instructions, Rotate Instructions, Stack Pointer.

UNIT -IV: Remote Sensing

Definition of remote sensing; introduction to concepts and systems; Electromagnetic radiation; electromagnetic spectrum; image characteristics; remote sensing systems; remote sensing platform; Sources of remote sensing information; Advantages of remote sensing. Application of Remote sensing in Environmental Management, Natural resource management–forest resources, water resources, land resources and mineral resources.

Books for Study

1. Nano structures and Nanomaterials: Synthesis, Properties and Application by Guozliong Cao, Imperial College Press (2004).
2. Introduction to Nano technology, By Charles P. Poole, Jr and Frank J. Owens, Willey India(2006).
3. An Introduction to Micro electro mechanical Systems Engineering by Nadim Maluf, Artech House Publishers, 2004
4. Nanomaterials Synthesis Properties and Applications, by Alen. S. Edelstein and Robert C. Cammarata, 1998.
5. The 8051 Micro controller and Embedded systems, by Mahammad Ali Mazidi and Janice Gillispie Mazidi, Pearson Education Asia, Pvt.Ltd.,2000.
6. Floyd F. Sabins Jr., Remote Sensing Principles and interpretation, by W.H. Free man and Company, 2nd Ed., New York, 1987.
7. T.M. Lilles and &R .W. Kiefer, Remote Sensing and Image Interpretation', by John Wiley & Sons, New York, 1994.
8. An Introduction to GIS by Ian Heywoodetal., Addision Wesley, Longmont Limited, England, 2011.

(Open Elective)

PHY – 306 (a)	Basic Spectroscopic Techniques	L-3,T-1,P-2	4Credits

Pre-requisite: Understanding of graduate level spectroscopy

Course Objectives: The aim and objective of the course on **Basic Spectroscopic Techniques** for the students of M.Sc. Physics is to equip them with the knowledge of Atomic, Rotational, Vibrational, Raman, and Electronic spectra.

Course Outcomes: At the end of the course, the student will be able to

CO1	Have the basic knowledge of Bohr's-Sommer field Quantum theory of hydrogen like atom
CO2	Understand classical/quantum description of electronic spectra of atom and molecules
CO3	Use microwave and Raman Spectroscopy for analysis of known molecules
CO4	Correlate infrared spectroscopic information of known molecules with their physical description

Mapping of course out comes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	2	1	1	2	2	3	1	2
CO2	2	2	3	3	2	1	2	2	2	3	1	1
CO3	2	2	3	3	2	1	2	2	2	3	1	3
CO4	2	2	3	3	2	1	2	2	2	3	1	3

PHY 306 (a): Basic Spectroscopic Techniques

UNIT I: Fundamentals of Spectroscopy

Introduction - Interaction of Electromagnetic radiation with matter - Spectra of Hydrogen atom-quantum numbers -Forbidden transitions and selection rules- Spectroscopic transition between two stationary states - Absorption and emission of a photon - Einstein A and B coefficients - Line shape functions -Spectral broadening mechanisms-Spin or bit interaction energy-Stern-Gerlach experiment-L Scoupling– JJ coupling – Hund's rule of multiplicity - Pauli's exclusion principle - Rotational and vibrational spectra of different molecules-Energy expressions**.**

UNIT– II: Spectro photometry

Introduction – Beer's law – Absorptivity – UV and visible absorption –Instrumentation – Essential partsofspectrophotometer–Gratingsandprisms–Radiantenergysources–Filters–Photosensitivedetectors – Barrier layer cells – Photo emissive cells – Photomultiplier tubes – Relationship between absorption in

the visible and UV region and molecular structure – IR Spectrophotometry – Fourier Transform Infrared (FTIR)Spectrometer–Molecularstructure–QualitativeandQuantitativeanalysis–Importance of photography in the spectrochemical analysis.

UNIT–III: Colorimeters, spectrophotometers and microscopes

Colorimeter – Principle - Applications of colorimeters in analytical and biomedical purposes Spectrophotometer-Principle and working with block diagram–Salient features of individual blocks– Specifications and operation of spectrophotometers– Applications of spectrophotometers to chemical analysis Electron microscope – Transmission electron microscope - Principle and working with block diagram –Salient features of individual blocks – Scanning electron microscope - Principle and working with block diagram– Description of individual blocks– Applications of electron microscopes.

UNIT–IV: Resonance spectrometers and Mass Spectrometer

Electron spin resonance–theory–ESR spectrometer–Principle and working with block diagram–Experimental techniques–Salient features of individual blocks– Applications of ESR.
Nuclear magnetic resonance–theory–NMR spectrometer-Principle and working with block diagram–Experimental techniques–Description of individual blocks– Applications of NMR.
Mossbauereffect–theory–Mossbauerspectrometer–PrincipleandworkingofMossbauerspectrometer -Experimental methods–Explanation of block diagram– Applications of Mossbauer studies.

Books for Study

1. Introduction to Atomic Spectra, H.E. White, Mc Graw- Hill Kogakusha. Ltd., New Delhi (1934).
2. Elements of Spectroscopy by Gupta, Kumar, Sarma, Pragati Prakasan,2012.
3. Spectrochemical Analysis, L. H. Ahrens and S.R. Tayler, Addison-Wesley, London, 1961.
4. Instrumental methods of Chemical analysis by Chatwal and Anand, Himalaya Publisher,2003
5. Spectroscopy by B.K. Sarma, Goel publishing House, Meerut,1993.
6. Spectroscopy VolI by Straughan and Walker, John Wileyand Sons,1976
7. Basic principles of Spectroscopy by Raymond Chang,Mic Graw Hill,1971
8. Molecular Structure and Spectroscopy by G. Aruldas, Prentice Hall of India,2001

(Open Elective)

PHY-306(a)	Nanomaterials and Devices	L-5,T-1,P-0	4Credits

Pre-requisite: Condensed matter physics

Course Objectives: The aim and objective of the course on **Physics of Nano-materials** is to familiarize the students of M.Sc. to the various aspects related to preparation, characterization and study of different properties of nanomaterials so that they can pursue this emerging research field as career.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understanding the basics of nanomaterials
CO2	Acquire knowledge of basic approaches to synthesize the nanaomaterials
CO3	Understand the physical and chemical properties of carbon nano tubes and nano structured materials.
CO4	Introduction to nanodevices

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	2	-	1	2	1	1	2	2	3
CO2	1	2	2	2	-	2	2	1	1	2	2	3
CO3	1	2	2	2	-	2	2	1	1	2	2	3
CO4	1	2	2	2	-	2	2	1	1	2	2	3

PHY 306 (b): Nanomaterials and Devices

UNIT-1: Introduction to Nanomaterials

Introduction to Nanomaterials-Zero, One and Two Dimensional Nanomaterials Quantum confinement, Density of states, Dependence of dimensionality–Physical and chemical properties.

UNIT–II: Synthesis of Nanomaterials

Introduction to Bottom –up and Top-down approaches

Ball milling –Inert Gas condensation – Physical vapor deposition -, Molecular Beam Epitaxy – Sputtering – Pulsed laser Deposition –Chemical vapor deposition - Sol Gel – Hydrothermal Synthesis

UNIT-III: Nano –Carbon

Carbon molecules: Nature of the carbon bond –New Carbon structure –carbon clusters –Smallcarbon clusters –Discovery of C_{60}–Structure of $C_{60}$and its properties –Synthesis of buckyballs and Applications.

Carbon Nanotubes: Fabrication –Structure -Electrical Properties – Mechanical properties –Applications of carbon Nanotubes

Graphene: Fabrication–Structure–ElectricalProperties–Mechanicalproperties–Applications.

UNIT–IV: Nano Devices

Introduction–Nanofabrication–Photo-Lithography–Patterntransfer–Introduction to MEMS –Single Electron Transistor–Solar Cells–Light Emitting diodes–Gas Sensors-Micro batteries –Field emission display devices –Fuel Cells.

Books for Study

1. Nano materials: Synthesis, operties and Applications–Edited by A.S. Edelstein and R.C. Cammarata, Institute of Physics Publishing, 2002.
2. Introudction to Nano technology–Charles P.Poole Jrand Frant J. Owens, Wiley Inter science, 2003.
3. Nano practices from Theroy to Applications edited by Gunter Schmid, Wiley VCH, 2004.
4. Nano electronics and Nano systems by K. Glosekotter and J. Dienstuthi (Springer), 2004.

(MandatoryCore)

PHY401:AdvancedQuantumMechanics

PHY- 401	Advanced Quantum Mechanics	L-5,T-1,P-0	4Credits

Pre-requisite: Preliminary course of Quantum Mechanics

Course Objectives: The aim and objective of the course on **Advanced Quantum Mechanics** is to introduce the M.Sc. students to the formal structure of the subject and to equip him/her with the concept of identical particles, angular momentum. Relativistic quantum mechanics and Quantum field theory so that he/she can use these in various branches of physics as per his/her requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the concept of identifiable particles
CO2	Understand the Orbital Angular momentum spin angular momentum and general angular momentum and their importance in spectroscopy
CO3	Give the significance of Klein Gordon and Dirac equation and explain the existence of antiparticles.
CO4	Apply the symmetries principles in calculating the conserved currents and charges.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	1	1	1	2	2	1	2	2
CO2	2	2	3	1	1	1	-	1	2	1	2	2
CO3	2	2	2	2	1	1	1	1	2	1	2	2
CO4	2	2	2	2	1	1	1	2	2	1	2	2

PHY- 401: Advanced Quantum Mechanics

UNIT-I: Identical Particles and Molecules

Identical particles- Indistinguishability of Identical particles- Construction of Symmetric and Anti-symmetric wave functions for two and three particle systems - Pauli's Exclusion Principle- Hydrogen molecule-Spin-orbit interaction-Ortho and Parahydrogen-Spin statistics connection.

UNIT-II: Angular Momentum

Introduction: Motion in Central Potential, Orbital Angular momentum –L_x, L_y,L_z,L_2,L^+ and L^- Operators -Commutation rules for angular momentum - Eigen values and Eigen functions of $L_z$and L^2 - Angular momentum in general - Allowed values of angular momentum J - Eigen valuesof $J_+$and J_-angular momentum matrices - Addition of angular momenta and Clebsh-

(MandatoryCore)

PHY401:AdvancedQuantumMechanics

Gorden co-efficients: Clebsh–Gorden co-efficient for $J_1=J_2=1/2$and$J_1=1,J_2=1/2$-spinangular momentum and Pauli's spin matrices.

UNIT-III: Relativistic Quantum Theory

Klein – Gorden Equation – KG equation in Co-variant form- Probability Density and Probability Current Density – Inadequacies of K.G. Equation – Dirac's Relativistic Equation for a Free Particle -Dirac`s Matrices – Dirac`s Equation in Co-variant form –Plane wave solution – Negative Energy States–Spin Angular Momentum-Existence.

UNIT-IV: Quantization of Wave Fields

Concept of Field-Method of Canonical Quantization: Lagrangian Formulation of Field, Hamilton Formulation of Field -Second Quantization –Field equation – Quantization of Non-relativistic Schrodinger equation – Commutation and Anti-Commutation Relations, The N-representation-System of Fermions and Bosons– Creation and Annihilation.

Books for Study

1. Quantum Mechanics: Concepts and Applications by Nouredine Zettili ,Wiley, Ed.,2021
2. Introduction to Quantum Mechanics by David J. Griffith sand Darrel lF.Schoeter, Third Ed., Cambridge University Press India PvtLtd.,2018.
3. Quantum Mechanics: G. Aruldas PHI learning private limited Second edition, 2018
4. Quantum Mechanics: S.L. Kakani and H.M. Chand alia Sultan Chand and, Sons First Edition, 2004
5. Advanced Quantum Mechanics: B.S. Rajput, Pragati prakasan,2019
6. Quantum Mechanics: V.K. Thankappan, New Age International(P)Ltd., Publishers,1993
7. A Text book of Quantum Mechanics :P.M. Mathews and K.Venkatesan, Tata Mc Graw Hill Publishing Company, 2008
8. Quantum Mechanics :S.L. Gupta, V. Kumar, H.V.Sharma and R.C.Sharma, Jai Prakash Nath and Company, 2007
9. An Introduction to Quantum Mechanics, P.T. Mathews Mc Graw Hill Publishing Company, 1974

(MandatoryCore)

PHY402:Physicsof AdvancedMaterials

PHY - 402	Physics of Advanced materials	L-3,T-1,P-2	4Credits
Pre-requisite: Understanding of graduate level solid state physics			
Course Objectives: The aim and objective of the course on Physics of Advanced materials is to expose the students of M.Sc. class to the topics like crystal growth, dielectric properties, ferromagnetic properties and functional materials, concepts and applications, so that they are equipped with the investigating the matter in the condensed phase.			
Course Outcomes: At the end of the course, the student will be able to			
CO1	Gain in-depth knowledge about the formation of various crystal Growth techniques		
CO2	Understand the properties dielectric and ferroelectric materials		
CO3	Understand different on Ferro and Anti ferro and ferro magnetism and their applications		
CO4	Study functional materials		

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1	2	1	2	2	2	1	2
CO2	2	2	2	2	2	2	2	2	2	2	2	2
CO3	2	2	1	2	1	2	2	2	1	2	1	2
CO4	2	2	1	2	2	2	1	2	1	2	2	2

PHY – 402: Physics of Advanced materials

UNIT-I: Crystal Growth and Imperfections in Crystals

Crystal growth: Nucleation and growth – Homogeneous and heterogeneous nucleation – Classification of crystal growth techniques–Melt growth: Bridgman, Czochralski techniques.
Imperfections: Classification of imperfections–Point defects–Schottky and Frenkel defects-Expressions for equilibrium defect concentrations – Colour centres –Production of colour centres – Line defects – Dislocations – Edge and Screw dislocations – Burger vector –Estimation of dislocation densities – Ordered phases of matter-Translational and orientational order

(MandatoryCore)

PHY402:Physicsof AdvancedMaterials

UNIT-II: Dielectrics and Ferroelectrics

Dielectrics: Introduction–Di polemoment– various types of polarization–Electronic, ionic and orientational polarization–Langevin's theory–Lorentz field–Clausius-Mosotti equation–Measurement of dielectric constant– Applications of dielectrics.
Ferroelectrics: Piezo-, Pyro- and ferroelectric crystals– Spontaneous polarization – Classification and properties of ferroelectrics - Ferroelectric domains – Oxygen ion displacement theory –Applications of ferroelectrics.

UNIT- III: Ferromagnetism and Anti-ferromagnetism

Ferromagnetism: Introduction – Weiss molecular field theory – Temperature dependence of spontaneousmagnetization–Heisenbergmodel–Exchangeinteraction–Ferromagneticdomains–Magneticbubbles–Blochwall –Thickness and energy–Ferromagnetic spin waves–Magnons–Dispersion relations.
Anti-ferro magnetism: Introduction–Twosublatticemodelofanti-ferromagnetism–Ferrimagnetism-Ferrites – Structure– Applications– Multiferroics

UNIT- IV: Functional Materials

Amorphous semiconductors: Band structure – Electronic conduction – Optical absorption – Applications.
Liquid crystals: Classification– Orientational order and inter molecular forces–Magnetic effect– Optical properties– Applications.
Polymers: Classification–Structuralpropertycorrelation–Molecularweight–Crystallineinpolymers–Applications.

Books for Study

1. Solid State Physics, C. Kittel, Edition:8th 2012, John Wiley & Sons.
2. Solid State Physics, A.J. Dekkar, Edition: 1st, 2000.Macmillan India Ltd.
3. Solid State Physics, M.A. Wahab, Edition:3rd, 2020, Narosa Publishing House.
4. Fundamentals of Solid State Physics, Saxena, Gupta, Saxena, Edition: 31st,2019, Pragathi
5. Solid State Physics, R.L. Singhal, 2018, Kedar Nath,Ram Nath & Co. Publications, Meerut.
6. Science of Engineering Materials and carbon nanotubes, C.M. Srivastsava and C.Srinivasan, Edition:3rd,2010 New Age Inter. Pub.
7. Crystal Growth, B.R. Pamplin,1977, Pergmon Press.
8. Crystal Growth from High Temperature Solutions, D.Elwell and H.J .Scheel, 1975, Academic Press.

(GenericElective)

PHY403(a):Photonics

PHY -403 (a)	Photonics	L-3,T-1,P-2	4Credits

Pre-requisite: Understanding of graduate level optics and Lasers

Course Objectives: Course Objectives: The aim and objective of the course on **Photonics** is to expose the M.Sc. students to the basics of the challenging research field of optical fibers and their use in integrated optics and photonic crystals.

Course Outcomes: At the end of the course, the student will be able to

CO1	In depth knowledge on different lasers and their application
CO2	Importance of Fiber optics and their components in communication and sensors
CO3	Significance and role of wage guides and optics in integrated optics
CO4	Advances in photonic crystals, circuits and applications with respect to conventional devices.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7e	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	1	-	1	-	1	-	3	-	1
CO2	3	2	1	1	1	1	-	1	-	3	-	1
CO3	2	2	-	1	-	1	-	1	-	3	-	1
CO4	3	2	1	1	1	-	-	1	-	3	-	1

PHY -403 (a): Photonics

UNIT–I: Laser systems, Properties and Applications

General description, structure, excitation mechanism and working of CO_2, Argonion, Free-electron, Dye, Nd: YAG, Optical parametric oscillator, semiconductor and erbium doped fiber lasers.
Laser beam line width, frequency stabilization, divergence and coherence. Q-Switching and Methods of Q-switching. Mode locking and methods of mode locking. Frequency doubling and phase conjugation. Laser applications in isotopic separation, velocity measurements, interferometry and speckle metrology.

UNIT- II: Fiber Optic Components and Sensors

Connector principles, Fiber end preparation, Splices, Connectors, Source coupling, Distribution networks, Directional couplers, Star couplers, Switches, Fiber optical isolator, Wavelength division multiplexing, Time division multiplexing, Fiber Bragg gratings. Advantage of fiber optic sensors, Intensity modulated sensors,
Mach-Zehnder interferometer sensors, Current sensors, Chemical sensors –Fiber optic rotation sensors. Optical biosensors: Fluorescence and energy transfer sensing, molecular beacons and optical geometries

of bio-sensing, Bio-imaging, Biosensing.

UNIT- III: Integrated Optics

Introduction – Planar wave guide – Channel wave guide – Y-junction beam splitters and couplers – FTIR beam splitters–Prism andgratingcouplers–Lenswaveguide–Fabricationofintegratedopticaldevices
- Integrated photodiodes – Edge and surface emitting laser – Distributed Bragg reflection and Distributed feed back lasers -Wave guide array laser.

UNIT-IV: Photonic Crystals

Basics concepts, Theoretical modeling of photonic crystals, Features of photonic crystals, Methods of fabrication, Photonic crystal optical circuitry, Nonlinear photonic crystals, Photonic crystal fibers, Photonic crystals and optical communications, Photonic crystal sensors.

Books for Study

1. Lasers: Principles and applications by J.Wilson and J.F.B. Hawkes, Prentice, Hall of India, New Delhi,1996.
2. Laser fundamentals, W.T. Silf vast, Foundation books, New Delhi,1999.
3. Fiber Optic Communication, Joseph C.Palais, Pearson Education Asia, India,2001
4. Introduction To Fibre Optics, A.Ghatak And K.Thyagarajan, Cambridge University Press , NewDelhi,1999
5. Optical Guided Wave Signal Devices, R. Syms And J. Cozens.Mc graw Hill,1993.
6. Optical Electronics, AGhatak and K. Thyagarajan, Cambridge University Press, New Delhi,1991
7. Fundamentals of Photonics, B.E.A. Sale hand M.C.Teich, John Willy and Sons,1991
8. Nanophotonics, P.N.Prasad, Wiley Interscience,2003.

(GenericElective)

PHY- 403 (b)	Solar Energy–Thermal and Photo voltaic Properties	L-3,T-1,P-2	4Credits

Pre-requisite: Understanding of graduate level semiconductor physics

Course Objectives: The aim and objective of the course on Solar Energy–Thermal and Photovoltaic Properties is to expose the M.Sc. students to the basics of solar energy.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the thermal and light components of solar energy, basic concepts and measurement of solar radiation.
CO2	Learn the theoretical aspects of solar collectors, performance evaluation and application.
CO3	Know the concepts of solar cells, types and fabrication procedures of source solar cells.
CO4	Provide knowledge on cell efficiency measurements.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	1	-	1	2	1	2	3	2	2
CO2	2	2	1	2	1	1	1	1	1	3	1	1
CO3	3	2	-	2	1	1	2	1	1	3	1	1
CO4	2	2	-	2	1	1	2	1	1	3	1	1

PHY403(b): Solar Energy–Thermal and Photo voltaic Properties

UNIT-I: Basic Concepts of Solar Energy

Introduction - Distribution of solar radiation – Solar Constant, Zenith Angle, Air Mass, Standard Time, Local Apparent Time, Equation of Time, Declination, Hour Angle, Azimuth Angles (all definitions only). Radiation Measurement using Pyranometer and Pyrheliometer–Principle and working.

Kirchoff's law – Solar transmittance, absorptance, emittance and reflectance – Their relation. Selective coatings - Methods of Preparation of coatings - Measurement of solar absorptance and emittance of a selective surface.

UNIT- II: Solar Thermal Collectors

Introduction, Collector types - Flat plate collector (FPC), Evacuated tube collector – Energy balance equation and efficiency, Definitions of collector overall heat loss coefficient, collector efficiency factor, collector heat-removal factor and collector flow factor, Temperature distribution in FPC - Testing of FPC, solar water heating - natural and forced circulation type; Concentrating collectors, types, single axis and two-axis tracking – Performance of Linear parabolic trough concentrator, Applications - Space heating, Air heater - Configurations - Drier - Principle and working; Energy storage - Sensible heat storage- liquid and pebble-bed storage, Thermo chemical storage.

UNIT–III: Solar Cells

Photovoltaic effect – Equivalent circuit of solar cell - Definitions of cell parameters, Type of cells, Crystalline silicon (c-Si), Float zone and Czochrolski methods - Wafer to cell formation steps**,** Poly-Siwafer growth methods – EFG, Web, Heat exchange method, Amorphous Si cells. Thin film cells –

Advantages and limitations – CdTe/ CdS, CuInGaSe2/CdS and Ga Ascells –Configurations and structures – Fabrication of these cells - I-V characteristics and spectral response - Multijunction cells - Quantum dot, Dyesensitized and Perovskite cells.

UNIT–IV: Solar Photo voltaic Systems

Photovoltaic (PV) Module assembly - Description of steps involved in the fabrication of solar module - Performance of module – I-V Characteristics, Modules design for different current and voltages – Module protection - Use of bypass and blocking diodes, Solar PV system - Components – PV Array, battery, invertor and load. Bifacial solar modules – Advantages over mono-facial cells; Applications of solar PV systems–Stand-alone system–Design methodologies, Hybrid system–Types and issues, Grid connected systems.

Books for Study

1. Solar Energy Utilization, G.D. Rai, KhannaPublishers,1987.
2. Solar Energy-Fundamentals, Design, Modelling and Applications, G.N.Tiwari, Narosa Publications, 2005.
3. Solar Energy-Principles of Thermal Energy Collection & Storage, S.P. Sukhatme, Tata Mc-Graw Hill Publishers, 1999.
4. Science and Technology of Photo voltaics, P.Jayarama Reddy , CRC Press(Taylor & Francis Group, Leiden, Netherlands) & BS Publications,2009.
5. Solar Photovoltaics-Fundamentals, Technologies and Applications, Chetan Singh Solanki, PHIL earning Pvt. Ltd.,2015.

(GenericElective)

PHY-403 (c)	Vacuum and Thin Film Technology	L-3,T-1,P-2	4Credits

Pre-requisite: course in Condensed Matter Physics

Course Objectives: The main objective of the course on vacuum and thin film technology is to introduce the basic and advanced concepts in the field of vacuum and thin films. The students are not only exposed to theoretical concepts but also have hands-on training in the preparation of thin films. The students also are exposed to various industrial applications of vacuum and thin films

Course Outcomes: At the end of the course, the student will be able to

CO1	Basic theoretical concepts of the kinetic theory of gases applicable to vacuum technology and also the principles and construction of various vacuum pumps and gages.
CO2	Design and construction of various techniques for the preparation of thin films
CO3	Theoretical aspects to understand the growth and properties of thin films
CO4	Various industrial applications of thin films

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	**2**	2	3	1	2	1	3	2	3	3
CO3	2	3	3	3	3	1	2	1	3	2	3	3
CO3	2	2	2	2	2	1	1	1	1	2	1	2
CO4	3	3	3	3	3	1	1	1	3	3	3	3

PHY403(c): Vacuum and Thin Film Technology

UNIT-I: Basics of Vacuum

Fundamentals of kinetic theory applicable to vacuum technology -Vacuum pumps: Rotary pump - Roots pump – Sorption pump – Diffusion pump -Turbo molecular pump – Cryogenic pump - Vacuum Gauges: Pirani gauge - Penning gauge - Hot cathode ionization gauge – Bayard –Alpert gauge –Quadruple mass spectrometer - Pump combinations – Design of vacuum systems – Leaks and Leak detection-Applications of vacuum.

UNIT- II: Preparation of Thin Films

Physical Methods: Vacuum evaporation -Resistive heating- Electron beam evaporation-Co-evaporation-Epitaxial deposition: Pulsed laserablation- Molecular beam epitaxy. Sputtering-Glow discharge-DC and RF sputtering-Reactive sputtering-Magnetron sputtering

- Chemical methods: Electroplating – Spray pyrolysis – Chemical vapor deposition (CVD) -Sol-gel– Spin coating.

Measurement of film thickness -Multiple beam interferometer (MBI) methods – Quartz crystal thickness monitor -Stylus profiler.

(GenericElective)

UNIT-III: Properties of Thin Films

Transport Properties of Thin Films**:** Metallic Films: Sources of resistivity in metallic conductors – sheet resistance and temperature coefficient of resistance of thin films – Influence of thickness on the resistivity of structurally perfect thin films – Fuchs Sondhemier theory – Annealing and agglomeration - Optical Properties -Reflection and transmission by single film and multi layer films -Optical absorption– Determination of optical constants by Ellipsometry.

UNIT-IV : Applications of Thin Films

Photolithography-PatternGeneration-Thinfilmresistors–Thinfilmcapacitors–Thinfilmdiodes and transistors – Thin film solar cells - Thin film micro batteries – Thin film Gas sensors –Reflection and antireflection coatings - Optical filters - Transparent conducting oxide coatings -Hard coatings -Tribological coatings.

Books for Study

1. Vacuum Technology, A. Roth, North-Holland,1986.
2. Vacuum Science and Technology, V.Vasudeva Rao, T.B. Ghosh and K.L.Chopra, Allied Publications,1998.
3. Handbook of Thin Film Technology, L.I. Maissel and R.L.Glang, Mc Graw HillBookCo.,1970.
4. Thin Film Phenomena, K.L. Chopra, Mc Graw Hill Book Co., New York,1969.
5. Vacuum Deposition on to Webs, Films and Foils, Charles A. Bishop, Elsevier, London,2011.
6. The Materials Science of Thin Films, M.Ohring, Academic Press, New York,1992.
7. The User's Guide to Vacuum Technology, J.F. O'Henlon, John Wiley & Sons, 2003.

(Multidisciplinary Course)

PHY-405	Advanced characterization techniques	L-3,T-1,P-0	4Credits

Pre-requisite: Understanding of graduate level chemistry and physics

Course Objectives: The aim and objective of the course on Advanced characterization Techniques is to familiarize the M.Sc. students with the basics of the recently emerging research field of dynamics of Structures, Spectra and properties of various instruments

Course Outcomes: At the end of the course, the student will be able to

CO1	Describe various Instrumentation – Essential parts of spectrophotometer.
CO2	Understand theoretical techniques Resonance Spectrometers and Mass Spectrometer
CO3	Understand use of various spectroscopic techniques and their application to the various fields of physics.
CO4	Understand the Advanced Spectroscopic and Microscopic Techniques

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	2	1	2	1	2	2	1	2
CO2	2	2	1	2	2	2	2	-	2	2	1	2
CO3	2	2	1	2	1	2	2	-	2	2	1	2
CO4	2	2	1	2	2	2	2	-	2	2	1	2

PHY405: Advanced Characterization Techniques

UNIT–I: Spectrophotometry

Introduction – Beer's law – Absorptivity – UV and visible absorption –Instrumentation – Essential parts of spectrophotometer–IR Spectrophotometry–Fourier Transform Infrared(FTIR) Spectrometer–Molecular structure – Qualitative and Quantitative analysis–Raman Spectroscopy – Qualitative and Quantitative analysis. Fourier Transform (FT) Raman Spectroscopy and its additional advantages over the conventional Raman Spectroscopy,

UNIT–II: Resonance Spectrometers and Mass Spectrometer

Electron Spin Resonance (ESR)–Principle–ESR spectrometer–Working Principle with block diagram – Applications of ESR. Nuclear Magnetic Resonance (NMR) – Principle – NMR spectrometer – Working Principle with block diagram – Experimental techniques –. Basic concepts of NQR spectra: Half integral and integral spins, Instrumentation, Super regenerative oscillator, applications of NQR. Mossbauer effect – theory – Mossbauer spectrometer – Principle and working of Mossbauer spectrometer – Experimental methods with block diagram– Applications of Mossbauer studies.

UNIT–III: Advanced Spectroscopic and Microscopic Techniques

Spectroscopic Techniques: Energy Dispersive Spectroscopy, X-ray Photo Electron Spectroscopy, X ray Fluorescence Spectroscopy and Auger Electron Spectroscopy, Secondary Ion Mass Spectrometry.
Imaging Techniques: Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy,
Diffraction Techniques: X-Ray diffraction –Laue method–Powder method.

Books for Study

1. Elements of X-ray Diffraction, B.D. Cullity,3rdEd., Pearson Education Ltd.,2014.
2. Methods of Surface Analysis, Techniques and Applications, J.M. Walls Cambridge
3. University Press, 1990.
4. X-ray Structure Determination, H.Stout and LH.Jenson, Macmillan, London,1968.
5. Instrumental Methods of Analysis, Willard Merritt, Dean Settle, CBS publishers,
6. New Delhi,1986
7. Spectroscopy, B.P. Straughan and S.Walker, John Wiley & Sons Inc.,NewYork,1976.
8. Spectroscopy, G.Chatwal and S.Anand, Himalaya Pub.,2002.
9. Spectroscopy, B.K. Sharma, Goel Publishers House, Meerut,1975.
10. Basic principles of Spectroscopy by Raymond Chang, Mic Graw Hill,1971
11. Molecular Structure and Spectroscopy by G.Aruldas, Prentice Hall of India,2001

(OpenElective)

PHY-406 (a)	Wireless Communications	L-3,T-1,P-2	4Credits

Pre-requisite: Understanding of graduate level chemistry and physics

Course Objectives: The aim and objective of the course on Wireless Communications is to familiarize the M.Sc. students with the basics of the recently emerging mobile technologies.

Course Outcomes: At the end of the course, the student will be able to

CO1	understand the basics of digital modulation techniques
CO2	Understand various coding and error correction techniques
CO3	Know GSM mobile communication standards, its architecture, logical channels, advantages and limitations.
CO4	Familiarize with optical and satellite communication techniques

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	2	1	2	1	2	2	1	2
CO2	2	2	1	2	2	2	2	-	2	2	1	2
CO3	2	2	1	2	1	2	2	-	2	2	1	2
CO4	2	2	1	2	2	2	2	-	2	2	1	2

PHY 406 (a): Wireless Communications

UNIT– I: Base Band Data Transmission

Digital Modulation techniques: BPSK, QPSK, DPSK, QASK, BFSK, MSK, M-ary techniques. Base band binary data transmission system – Inter symbol interference – Nyquist pulse shapingcriteria–linecoding,pulseshaping,andscramblingtechniques,Detectionoferrorprobability.

UNIT–II: Codes for Error Detection and Correction

Linear block codes, Convolutional codes. Encoding, Decoding of convolutional codes, State, Tree and Trellis diagrams. Maximum likelihood – Viter by algorithm, Burst error correction - Inter leaving techniques–Block and convolutional inter leaving, Types of ARQ.

UNIT–III: Introduction to Wireless Communication Systems

Global system for mobile (GSM): cellular concept, system design. Transmission system, receiving system; frequency re-use; Spread spectrum modulation; Multiple access techniques as applied to wireless communications; 1G,2G, 3G wireless networks.

(OpenElective)

UNIT–IV: Satellite and Optical Communications

Introduction Satellite systems: Orbiting satellites, satellite frequency bands, communication satellite system-modulation and multiple access format-satellite systems in India, Satellite receiving systems, G/T ratio, satellite uplink and down link analysis. Applications to communications and remote sensing. Introduction to Optical communications systems: Optical fibers, sources and detectors, analog and digital systems.

Books for Study

1. Modern Digital and Analog communication system by B.P. Lathi: .Oxford 3rd ed.,2011
2. Digital Communications Fundamentals and Applications by Bernard Sklar, Sklar Person Education, 2008
3. Principles of Communication Systems: Taub & Schilling, Tata Mc Graw-Hill,1991
4. Principles of Communication, R.E.Ziemer, WH Tranter Fifth Edition John Wiley (fifth module)
5. Wayne Tomoasi: Morden Electronic Communication Systems. Person Education/PHI,2014
6. John G Proakis: Digital Communication. MGH
7. Digital Communication Techniques Simon, Hindey Lindsey PHI
8. Communication Systems :Simon Haykin, John Wiley & Sons. Pvt. Ltd.
9. Digital and Analog Communication System : KSam Shanmugam. John Wiley
10. Communication Systems Engineering: Proakis, Pearson Education
11. Digital & Analog Communication System– Leon W Couch, Pearson Education/PHI.
12. Introduction to statistical Signal Processing with Applications MD Srinath, P.K. Rajasekaran, RE. Viswnathan PHI
13. Analog and Digital Communication MS Roden PHI
14. Digital modulation and coding. Wilson, Pearson Education
15. Applied coding and information Theory forengineers, Wells, Pearson education.

(OpenElective)

PHY-406 (b)	Vacuum Technology and applications	L-3,T-1,P-2	4Credits

Pre-requisite: course in Condensed Matter Physics

Course Objectives: The main objective of the course on vacuum technology and applications is to introduce the basic and advanced concepts in the field of vacuum technology. The students are not only exposed to theoretical concepts but also have hands-on training in the construction of various vacuum pumps, vacuum measuring gauges, and thin film preparation techniques. The students also are exposed to various industrial applications of vacuum and thin films

Course Outcomes: At the end of the course, the student will be able to

CO1	Basic theoretical concepts of the kinetic theory of gases applicable to vacuum technology and also the principles and construction of various vacuum pumps and gages for the production and measurement of vacuum
CO2	Design and construction of various components for the construction of vacuum systems for the preparation of thin films
CO3	Various techniques used for the growth of thin films
CO4	Various industrial applications of vacuum technology and thin films

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	3	1	2	1	3	2	3	3
CO3	2	3	3	3	3	1	2	1	3	2	3	3
CO3	2	2	2	2	2	1	1	1	1	2	1	2
CO4	3	3	3	3	3	1	1	1	3	3	3	3

406 (b) Vacuum Technology and Applications

UNIT-I: **Basics of Vacuum**

Vacuum – definition – Units of Vacuum – Vacuum ranges - Kinetic theory of gases related to vacuum -Physical parameters at low pressures–Vacuum components- Applications of vacuum – Vacuum metallurgy – Freeze drying – Vacuum in electrical applications – Space simulators– Leaks and detection of leaks– Pressure test– Halogen leak detector– Mass spectrometric leak detection.

UNIT-II: **Production and Measurement of Vacuum**

Classification of vacuum pumps – Rotary pump – Roots pump – Sorption pump – Diffusion pump– Turbo-molecular pump–Ion pump – Cryogenic pump.
Classification of vacuum gauges – McLeod gauge – Pirani gauge – Ionization gauges – Penning gauge – Bayard Alpert gauge – Measurement of partial pressure –Residual gas analyzer – Pump combinations– Construction of high vacuum coating system.

(OpenElective)

UNIT-III : **Preparation of Thin Films**

Physical Methods- Vacuum evaporation - Resistive heating - Electron beam evaporation -Co-evaporation.
Epitaxial deposition-Pulsed laserablation- Molecular beamepitaxy.
Sputtering - Glow discharge - DC and RF sputtering - Reactive sputtering - Magnetron sputtering
Chemical methods: Electroplating – Spray pyrolysis – Chemical vapour deposition (CVD) -Sol-gel– Spin coating.

UNIT-IV : **Applications of Thin Films**

Photolithography-Pattern generation- Thin film resistors – Thin film capacitors – Thin film diodes and transistors – Thin film solar cells - Thin film micro batteries – Thin film gas sensors – Reflection and antireflection coatings - Optical filters - Transparent conducting oxide coatings - Hard coatings-Tribological coatings.

Books for Study

1. Vacuum Technology, A.Roth, 3rd Edition, North-Holland Publications,2012.
2. Vacuum Science and Technology, V.V. Rao, T.B. Ghosh and K.L.Chopra, 3rdEditions, Allied Publications, 2008.
3. Handbook of Thin Film Technology, L.I. Maissel and R.L. Glang, Mc Graw Hill Book Co., 1970.
4. Thin Film Phenomena, K.L. Chopra, Mc Graw Hill Book Co., New York,1969.
5. Vacuum Deposition on to Webs, Films and Foils, Charles A. Bishop, Elsevier, London, 2015
6. The Materials Science of Thin Films, M.Ohring, Academic Press, New York,1992.
7. The User's Guide to Vacuum Technology, J.F.O'Henlon, John Wiley & Sons, 2003.

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-20)

Table 1.1.1. Details of courses addressing Local, National, Regional and Global Developmental Needs.

I. Local Needs

Programme name	Programme code	Course name	Course code	Year of Introduction
R20				
B.Tech	**1-1422777024**	Mathematics – I	MA 101	2020
		Engineering Chemistry	CY 101(**2**)	2020
		English	EN103	2020
		Basic Electrical & Electronics Engineering	EE 104	2020
		Engineering Graphics & Design	ME 105	2020
		English Communication Lab	EN 106	2020
B.Tech	**1-1422777024**	Mathematics – II	MA 201	2021
		Engineering Physics	PY 202	2021
		Programming for Problem solving	CS 203	2021
		Engineering Mechanics	CE 204	2021
		Workshop/Manufacturing Practices	ME 205	2021
		Programming for Problem solving Lab	CS 206	2021
		Environmental Science	CE 207	2021
B.Tech	**1-1422777024**	Mathematics – III*(Common to all branches)*	MA301BS	2021
		Strength of Materials	CE302C	2021
		Managerial Economics and Accountancy *(Common to all branches)*	HS303CO	2021
		Surveying	CE304C	2021
		Building Materials and Construction Technology	CE305C	2021
		Engineering Geology	CE306C	2021

		Surveying Lab	CE 307P	2021
		Materials Testing Lab	CE 308P	2021
		Skill Development Course1	CE309S	2021
		Constitution of India*(Common to all branches)*	PA310A	2021
		NCC/NSS	MC411B	2021
B.Tech	1-1422777024	Probability &Statistics *(Common to all branches)*	MA401C	2022
		Concrete Technology	CE402C	2022
		Fluid Mechanics and Hydraulic Machines	CE403C	2022
		Structural Analysis-I	CE404C	2022
		Water Quality and Treatment	CE405C	2022
		Soil Mechanics	CE406C	2022
		Fluid Mechanics and Hydraulic Machines Lab	CE407P	2022
		Soil Mechanics Lab	CE408P	2022
		Skill Development Course 2	CE409S	2022
		Computer Aided Building Drawing	CE410P	2022
		NCC/NSS/NSO	MC411B	2022

I. National Initiatives/Needs

National green Energy Initiatives:

Programme name	Programme code	Course name	Course code	Year of Introduction
B.Tech	1-1422777024	Environmental Science	CE 207	2021
		Environmental Engg. -1	CE405C	2022

National Biotechnology Initiatives:

Programme name	Programme code	Course name	Course code	Year of Introduction

B.Tech	**1-1422777024**	----	---	--

Geographical Integration System (GIS) Initiatives:

Programme name	Programme code	Course name	Course code	Year of Introduction
B.Tech	**1-1422777024**	Surveying	CE304C	2021
		Surveying Lab	CE 307P	2021

National Digital Initiative:

Programme name	Programme code	Course name	Course code	Year of Introduction
B.Tech	**1-1422777024**	----	---	--

Initiatives on Environment & Sustainability:

Programme name	Programme code	Course name	Course code	Year of Introduction
B.Tech	**1-1422777024**	Environmental Science	CE 207	2021
		Environmental Engg. -1	CE405C	2022

Initiatives on Water Resources:

Programme name	Programme code	Course name	Course code	Year of Introduction
B.Tech	**1-1422777024**	Fluid Mechanics and Hydraulic Machines	CE403C	2022
		Fluid Mechanics and Hydraulic Machines Lab	CE407P	2022

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-20)

Initiatives on Agricultural Sustainability:

Programme name	Programme code	Course name	Course code	Year of Introduction
B.Tech	1-1422777024	----	---	--

Initiatives on Health Promotions:

Programme name	Programme code	Course name	Course code	Year of Introduction
B.Tech	1-1422777024	----	---	--

Initiatives on Nanovission:

Programme name	Programme code	Course name	Course code	Year of Introduction
B.Tech	1-1422777024	----	---	--

Initiatives on Translational Mission:

Programme name	Programme code	Course name	Course code	Year of Introduction
B.Tech	1-1422777024	----	---	--

Initiatives on Sarva Siksha Abhiyan:

Programme name	Programme code	Course name	Course code	Year of Introduction
B.Tech	1-1422777024	----	---	--

Initiatives on Rural Development:

Programme name	Programme code	Course name	Course code	Year of Introduction
B.Tech	1-1422777024	----	---	--

II. Regional needs:

Programme name	Programme code	Course name	Course code	Year of Introduction
B.Tech	1-1422777024	----	---	--

III. Global Needs:

Programme name	Programme code	Course name	Course code	Year of Introduction
B.Tech	1-1422777024	----	---	--

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-20)

1.1.3. Employability/ Entrepreneurship/ Skill development – Mapping

S. No.	Name of the Programme	Course Code	Title of the Course	Year of Introduction	Employ ability	Entrepre neurship	Skill development
1	**B.Tech**	MA 101	Mathematics – I	2020	√		
2		EN103	English	2020	√		
3		EN 106	English Communication Lab	2020	√		
4		ME 105	Engineering Graphics & Design	2020			√
5		EN 106	English Communication Lab	2020			√
6		MA 201	Mathematics – II	2021	√		
7		CS 203	Programming for Problem solving	2021	√		
8		CE 204	Engineering Mechanics	2021	√		
9		ME 205	Workshop/Manufacturing Practices	2021	√		
10		CS 206	Programming for Problem solving Lab	2021	√		
11		CE 207	Environmental Science	2021	√		
12		ME 205	Workshop/Manufacturing Practices	2021			√
13		CS 206	Programming for Problem solving Lab	2021			√
14		MA301BS	Mathematics – III*(Common to all branches)*	2021	√		
15		CE302C	Strength of Materials	2021	√		
16		CE304C	Surveying	2021	√		
17		CE305C	Building Materials and Construction	2021	√		

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-20)

			Technology				
18		CE306C	Engineering Geology	2021	√		
19		CE 307P	Surveying Lab	2021	√		
20		CE309S	Skill Development Course1	2021	√		
21		CE304C	Surveying	2021		√	
22		CE305C	Building Materials and Construction Technology	2021		√	
23		CE 307P	Surveying Lab	2021		√	
24		HS303CO	Managerial Economics and Accountancy *(Common to all branches)*	2021			√
25		CE304C	Surveying	2021			√
26		CE 307P	Surveying Lab	2021			√
27		CE309S	Skill Development Course1	2021			√
28		PA310A	Constitution of India*(Common to all branches)*	2021			√
29		MA401C	Probability &Statistics *(Common to all branches)*	2022	√		
30		CE402C	Concrete Technology	2022	√		
31		CE403C	Fluid Mechanics and Hydraulic Machines	2022	√		
32		CE404C	Structural Analysis-I	2022	√		
33		CE405C	Water Quality and Treatment	2022	√		
34		CE406C	Soil Mechanics	2022	√		

35		CE407P	Fluid Mechanics and Hydraulic Machines Lab	2022	√		
36		CE408P	Soil Mechanics Lab	2022	√		
37		CE409S	Skill Development Course 2	2022	√		
38		CE410P	Computer Aided Building Drawing	2022	√		
39		MC411B	NCC/NSS/NSO	2022	√		
40		CE402C	Concrete Technology and Construction Equipment	2022		√	
41		CE404C	Structural Analysis	2022		√	
42		CE406C	Soil Mechanics	2022		√	
43		CE408P	Materials Testing Lab	2022		√	
44		CE410P	Computer Aided Building Drawing	2022		√	
45		MC411B	NCC/NSS	2022			√
46		CE409S	Skill Development Course 2	2022			√
47		CE410P	Computer Aided Building Drawing	2022			√

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-20)

1.1.3. Average percentage of Courses having focus on Employability/ Entrepreneurship/ Skill development during the last five years.

S. No	Course Code	Title of the Course	Year of Introduction	Average percentage of Courses having focus on Employability during the last five years
1	MA 101	Mathematics – I	2020	**27/35= 77.1%**
2	EN103	English	2020	
3	EN 106	English Communication Lab	2020	
4	MA 201	Mathematics – II	2021	
5	CS 203	Programming for Problem solving	2021	
6	CE 204	Engineering Mechanics	2021	
7	ME 205	Workshop/Manufacturing Practices	2021	
8	CS 206	Programming for Problem solving Lab	2021	
9	CE 207	Environmental Science	2021	
10	MA301BS	Mathematics – III*(Common to all branches)*	2021	
11	CE302C	Strength of Materials	2021	
12	CE304C	Surveying	2021	
13	CE305C	Building Materials and Construction Technology	2021	
14	CE306C	Engineering Geology	2021	
15	CE 307P	Surveying Lab	2021	
16	CE309S	Skill Development Course1	2021	
17	MA401C	Probability &Statistics *(Common to all branches)*	2022	
18	CE402C	Concrete Technology	2022	
19	CE403C	Fluid Mechanics and Hydraulic Machines	2022	
20	CE404C	Structural Analysis-I	2022	
21	CE405C	Water Quality and Treatment	2022	

22	CE406C	Soil Mechanics	2022	
23	CE407P	Fluid Mechanics and Hydraulic Machines Lab	2022	
24	CE408P	Soil Mechanics Lab	2022	
25	CE409S	Skill Development Course 2	2022	
26	CE410P	Computer Aided Building Drawing	2022	
27	MC411B	NCC/NSS/NSO	2022	

S. No	Course Code	Title of the Course	Year of Introduction	Average percentage of Courses having focus on Entrepreneurship during the last five years
1	CE304C	Surveying	2021	**8/34= 23.5%**
2	CE305C	Building Materials and Construction Technology	2021	
3	CE 307P	Surveying Lab	2021	
4	CE402C	Concrete Technology and Construction Equipment	2022	
5	CE404C	Structural Analysis	2022	
6	CE406C	Soil Mechanics	2022	
7	CE408P	Materials Testing Lab	2022	
8	CE410P	Computer Aided Building Drawing	2022	

S. No	Course Code	Title of the Course	Year of Introduction	Average percentage of Courses having focus on Skill development during the last five years
1	ME 105	Engineering Graphics & Design	2020	
2	EN 106	English Communication Lab	2020	
3	ME 205	Workshop/Manufacturing Practices	2021	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-20)

4	CS 206	Programming for Problem solving Lab	2021	**12/34= 35.3%**
5	HS303CO	Managerial Economics and Accountancy *(Common to all branches)*	2021	
6	CE304C	Surveying	2021	
7	CE 307P	Surveying Lab	2021	
8	CE309S	Skill Development Course1	2021	
9	PA310A	Constitution of India*(Common to all branches)*	2021	
10	MC411B	NCC/NSS	2022	
11	CE409S	Skill Development Course 2	2022	
12	CE410P	Computer Aided Building Drawing	2022	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-20)

1.2.1. Percentage of new Courses introduced of the total number of courses across all programmes offered during the last five years.

S. No	Course Code	Title of the Course	Year of Introduction	If revision has been carried out in the syllabus during last 5 years, Percentage of content added or replaced
1	HS303CO	Managerial Economics and Accountancy *(Common to all branches)*	2021	**6/34= 17.6%**
2	CE309S	Skill Development Course1	2021	
3	PA310A	Constitution of India*(Common to all branches)*	2021	
4	MC411B	NCC/NSS	2021	
5	MA401C	Probability &Statistics *(Common to all branches)*	2022	
6	CE409S	Skill Development Course 2	2022	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-20)

S. No	Course Code	Title of the Course	Year of Introduction	Activities/Content with direct bearing on Employability/Entrepreneurship/Skill development
	I Semester			
1.	**III Semester**			
2.	HS303CO	Managerial Economics and Accountancy *(Common to all branches)*	2021	Understand Macro Economic environment of the business and its impact on enterprise and to Understand the concepts of financial management and smart investment.
3.	CE309S	Skill Development Course1	2021	To Excel in MS Office
4.	PA310A	Constitution of India*(Common to all branches)*	2021	Understand historical background of the constitution making and its importance for building a democratic India and apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy
5.	MC411B	NCC/NSS	2021	
6.	**IV Semester**			
7.	MA401C	Probability &Statistics *(Common to all branches)*	2022	To impart knowledge in basic concepts and few techniques in probability and statistics in relation to the engineering applications and Apply different algorithms for approximating the solutions of ordinary differential equations to its analytical computations
8.	CE409S	Skill Development Course 2	2022	To excel in Auto CADD
9.	MC411B	NCC/NSS	2022	

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-20)

Table. 1.3.1. Courses which address Professional Ethics, Gender, Human Values, Environment and sustainability into the curriculum.

A. Professional Ethics:

Programme name	Programme code	Course name	Course code	Year of Introduction	Description of the course addressing Professional Ethics
B.Tech	1-1422777024	----	---	--	

B. Gender:

Programme name	Programme code	Course name	Course code	Year of Introduction	Description of the course addressing Professional Ethics
B.Tech	1-1422777024	----	---	--	

C. Human Values:

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
DEPARTMENT OF CIVIL ENGINEERING
B.Tech. Civil Engineering (R-20)

Programme name	Programme code	Course name	Course code	Year of Introduction	Description of the course addressing Professional Ethics
B.Tech	1-1422777024	----	---	--	

D. Environment & sustainability:

Programme name	Programme code	Course name	Course code	Year of Introduction	Description of the course addressing Professional Ethics
B.Tech	1-1422777024	Environmental Science	CE 207	2021	Introducing diverse components of environment and natural resources ecosystem and biodiversity and its conservation methods.
		Environmental Engg. -1	CE405C	2022	Estimate the water demand of any area and water conveyance systems.

DEPARTMENT OF CIVIL ENGINEERING
S.V.U. COLLEGE OF ENGINEERING
SRI VENKATESWARA UNIVERSITY: TIRUPATI

CURRICULUM FOR B.TECH CIVIL ENGINEERING (REGULAR) PROGRAMME TO BE IMPLEMENTED WITH EFFECT FROM THE ACADEMIC YEAR 2021-2022

SYLLABUS
Choice Based Credit System (CBCS)

Vision:

Vision of the Civil Engineering Department is to produce globally competitive and committed Civil Engineers with ethical values to cater to the needs of the society and strive for sustainable development through research and innovation.

Mission:

- To impart quality education with the support of state-of-art Infrastructure and Faculty.
- To inculcate inquisitiveness, infuse training and research for the societal development.
- To address growing needs of sustainable infrastructure development.
- To provide technical advice and support to the industry.
- To provide awareness of global economic problems and contribute to Nation building.
- To provide entrepreneurial skills for the upliftment of the country.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

a. To provide students with the fundamental, technical knowledge and skills in mathematics, sciences and engineering to recognize, analyze and solve complex problems in the areas of Structural, Geotechnical, Hydraulics and Water Resources, Transportation and Environmental engineering.

b. To provide students with individual working skills and practical experience and to fulfill their professional duties and communicate effectively in teamwork, ethical thinking, technical leadership, and lifelong learning.

c. To make the students responsible professionals to work in various positions in industry or government and/or succeed in graduate or other professional organizations.

d. To train the students to become engineers, managers, scientists, researchers and innovators and make substantial contributions to the society.

e. To guide the students to use modern tools to solve complex engineering problems

f. To make the students to strive for the improvement of the quality of life and improve the standard of living by providing environmental sustainability.

PROGRAMME OUTCOMES

POs describe what students are expected to know or be able to do by the time of graduation from the program. Program Outcomes are established as per the process described below.

Program Outcomes of B. Tech in Civil Engineering are:

1. To apply knowledge of mathematics, Science, Engineering fundamentals, and engineering specialization for the solution of complex engineering problems.
2. To identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. To design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

4. To use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
5. To create, select, and apply appropriate techniques, resources, and modernengineering and IT tools, including prediction and modeling to complex engineering activities, with an understanding of the limitations.
6. To apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. To understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. To apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. To function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. To communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. To demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. To recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

I Semester

Code	Category	Course Title	Scheme of Instruction (hr/Week)			Total Instruction	Credits
			Lecture	Tutorial	Practical		
MA 101	Basic Sci.	Mathematics – I	3	1	-	4	**4**
CY 101	Basic Sci	Engg. Chemistry	3	1	-	4	**4**
EN103	Humanities	English	2	-	-	2	**2**
EE104	Basic Engg	Basic Electrical & Electronics Engineering	3	1	-	4	**4**

ME105	Basic Engg	Engineering Graphics and Design	2	-	3	5	**3.5**
EN 106	Humanities Lab	English Communication Lab	-	-	3	3	**1.5**
		TOTAL	13	3	6	22	**19**

MA 101 MATHEMATICS –I

(I Semester - Common for all branches)

Instruction: 3(L) +1(T) /week Credits:4 Assessment: 40 + 60

UNIT I

Differential Equations: Linear differential equations of second and higher order with constant coefficients-particular integrals-homogeneous differential equations with variable coefficients-method of parameters-simulation equations.

UNIT II

Laplace Transforms I: Laplace transforms of standard functions-inverse transforms-transforms of derivatives and integrals-derivatives of transforms-integrals of transforms.

UNIT III

Laplace Transforms II: Transforms of periodic functions-convolution theorem-applications to solution of ordinary differential equations.

UNIT IV

Calculus: Roll's and Mean value theorems - Taylor's and Maclaurins's series-maxima and minima for functions of two variables - Infinite series - Convergence Tests series of positive terms - comparison, Ratio tests - Alternating series - Leibnitz's rule - Absolute and conditional convergence.

UNIT V

Multiple Integrals: Curve tracing (both Cartesian and polar coordinate) - Evaluations of double and Triple integrals-change of order of integrations-change of variables of integrations-simple applications to areas and volumes.

Text/Reference Books

1. B S Grewal, Higher Engineering Mathematics, 40th Edition, Khanna Publications, 2007.
2. M K Venkataraman, Engineering Mathematics, National Publishing Company, Chennai.
3. B V Ramana, Higher Engineering Mathematics, 6th Reprint, Tata McGraw-Hill, 2008.
4. Bali and Iyengar, Engineering Mathematics, 6th Edition, Laxmi Publications, 2006.

Course Outcomes: At the end of the course, students will be able to

1. analyze differential equations and solve them
2. apply differential equations to engineering problems.
3. Use transformation to convert one type into another type presumably easier to solve.
4. use shift theorems to compute the Laplace transform, inverse Laplace transform and the solutions of second order, linear equations with constant coefficients.
5. solve an initial value problem for an nth order ordinary differential equation using the Laplace transform.
6. expand functions as power series using Maclaurin's and Talor's series
7. optimize the problems related to OR, Computer science, Probability and Statistics
8. draw an approximate shape by the study of some of its important characteristics such as symmetry, tangents, regions enclosing curve tracing method to find length, area, volume.
9. use multiple integral in evaluating area and volume of any region bounded by the given curves.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1				2	2					1
CO2		1		2		1	1					
CO3		2			1		2					2
CO4				1	1		2					
CO5	1			1	2		1					
CO6												
CO7												
CO8												
CO9												

CY 101 ENGINEERING CHEMISTRY

Instruction: 3(L) +1(T) /week Credits: 4 Assessment: 40 + 60 UNIT I

Atomic and molecular structure (12 lectures)

UNIT I

Postulates of quantum chemistry. Schrodinger equation. Particle in a box solutions, Molecular orbitals of diatomic molecules and plots of the multicenter orbitals, Equations for atomic and molecular orbitals, Energy level diagrams of diatomics, Pi-molecular orbitals of butadiene and benzene. Band structure of solids and the role of doping on band structures

UNIT II

Spectroscopic techniques and applications

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclearmagnetic resonance and magnetic resonance imaging, surface characterization techniques.

UNIT III

Chemical equilibria, Intermolecular forces and potential energy surfaces

Use of free energy in Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Cellpotentials, the Nernst equation and applications.

Use of free energy considerations in metallurgy through Ellingham diagram. Equations of state of real gases and critical phenomena.

UNIT IV

Periodic properties

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular

geometries, Born- Haber cycle, The use of reduction potentials, Properties of ionic and covalent compounds.

UNIT V

Stereochemistry, Organic reactions and synthesis of a drug molecule

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings Synthesis of a commonly used drug molecule.

Reference/Textbooks

University chemistry, by B. H. Mahan

Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane 3.Fundamentals of Molecular Spectroscopy, by C. N. Banwell

Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan

Physical Chemistryby P. W. Atkins

Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Ed.

Principles of physical chemistry, Puri, Sharma and Pattania

Course Outcomes: At the end of the course, students will be able to

1. analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2. rationalize bulk properties and processes using thermodynamic considerations.
3. distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
4. rationalize periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
5. list major chemical reactions that are used in the synthesis of molecules.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1				2	2					1
CO2		1		2		1	1					
CO3		2			1		2					2
CO4				1	1		2					
CO5	1			1	2		1					

EN 103 ENGLISH

Instruction: 2(L) Credits: 2 Assessment: 40 + 60

UNIT I Vocabulary Building

The concept of Word Formation- Root words from foreign languages and their use in English- Acquaintance with prefixes and suffixes from foreign languages in English form derivatives- Synonyms, antonyms, and standard abbreviations.

UNIT II Basic Writing Skills

Sentence Structures – Use of phrases and clauses in sentences –Importance of proper punctuation - Creating coherence – Organizing principles of paragraphs in documents -Techniques for writing precisely

UNIT III Identifying Common Errors in Writing

Subject-verb agreement -Noun-pronoun agreement -Misplaced modifiers -Article -Prepositions - Redundancies -Clichés

UNIT IV Nature and Style of sensible Writing

Describing - Defining - Classifying –Providingexamples or evidence –Writingintroductionand conclusion

UNIT V Writing Practices

Comprehension - Précis Writing –EssayWriting

Reference/Textbooks:

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. On Writing Well. William Zinsser. Harper ResourceBook. 2001
4. Study Writing. LizHamp- Lyonsand Ben Heasly. Cambridge University Press. 2006.
5. Communication Skills. Sanjay KumarandPushpalata. Oxford University Press. 2011.
6. Exercises in Spoken English. Parts.I-III. CIEFL, Hyderabad. Oxford University Press

Course Outcomes: At the end of the course, students will be able to

1. learn the elements of grammar and composition of English Language.
2. Learn literary texts such as Short stories and prose passages.
3. maintain linguistic competence through training in vocabulary, sentence structures and pronunciation.
4. develop communication skills by cultivating the habit of reading comprehension passages.
5. develop the language skills like listening, speaking, reading and writing.
6. Make use of self-instructed learner friendly modes of language learning through competence.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2									
CO2	2		2	2								
CO3		1		2	2							
CO4			2	2	3							
CO5		1	1	2								
CO6												

EE104BASIC ELECTRICAL AND ELECTRONICS ENGG.

Instruction: 3(L) +1(T) /week Credits: 4 Assessment: 40 + 60

Unit-I

Electric DC Circuits: Kirchhoff's Voltage & Current laws, Superposition Theorem, Star – Delta Transformations.

AC Circuits: Complex representation of Impedance, Phasor diagrams, Power & Power Factor, Solution of Single Phase Series & Parallel Circuits. Solution of Three Phase circuits and Measurement of Power in Three Phase circuits.

Unit-II

Single Phase Transformers: Principle of Operation of a Single phase Transformer, EMF equation, regulation and Efficiency of a single phase transformer.

DC Machines: Principle of Operation, Classification, EMF and Torque equations, Characteristics of Generators and Motors

UNIT-III

Three Phase Induction Motor: Principle of Rotating Magnetic Field, Principle of Operation of 3- ϕ I.M., Torque-Speed Characteristics of 3-ϕ I.M.

UNIT-IV

p-n junction operation, diode applications, Zener diode as regulator.

Transistor and applications: Introduction to transistors, BJT Characteristics, biasing and applications

UNIT-V

Integrated Circuits: Operational amplifiers, Applications: adder, subtractor, Integrator and Differentiator.

Digital Circuits: logic gates, Combinational Logic circuits, Flip-Flops, counters and shift registers, Laboratory measuring instruments: digital multi-meters and Cathode Ray Oscilloscopes (CRO's).

Textbooks:

1. Electrical Technology by Edward Hughes
2. Basic Electrical Engineering by Nagrath and Kothari

Course Outcomes: At the end of the course, students will be able to

1. understand the basic concepts of D.C. single phase and 3- phase supply and circuits and solve basic electrical circuit problems
2. understand the basic concepts of transformers and motors used as various industrial drives
3. understand the concept of power factor improvement for industrial installations and concepts of most economical power factor
4. understand the operation and characteristics of diodes, transistors, integrated circuits and digital circuits.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1		1		1			1	
CO2	2	2	2	1		1		1			1	
CO3	2	2	2	1		1		1			1	
CO4	2	2	2	1		1		1			1	

ME 105 ENGINEERING GRAPHICS AND DESIGN

Instruction: 2(L) +3 (Drg) /week Credits: 3.5 **Assessment: 40 + 60**

Unit I Introduction to Engineering Drawing

Principles of Engineering Graphics and their significance, usage of Drawing instruments,lettering, Conic sections including the Rectangular Hyperbola (General method only);Cycloid,Epi-cycloid, Hypo- cycloid and Involutes.

Unit II

Scales- Scales– construction of Plain &Diagonal Scales.

Projections of points, lines - Projections of Points and lines inclined to both planes, including traces;

Question Paper Modular – 4 questions from Units I t0 IV, 15 marks each

Unit III

Projections of planes

Projections of planes (Regular surfaces only) inclined Planes-Auxiliary Planes

Projections of Regular Solids (Simple solids – cylinder, cone, prism & pyramid) those inclined to both the Planes-Auxiliary Views

Unit IV

Isometric Projections& Orthographic projections

Principles of Orthographic Projections-Conventions Draw simple objects, dimensioning and scale. Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.

Unit V Introduction to CAD

CAD workstation and peripherals, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars Standard, Object Properties, Draw, Modify and Dimension, Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom used in CAD, Select and erase objects.;

Text/Reference Books:

1. Bhatt N.D., Panchal V.M. &Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah,M.B.&RanaB.C.(2008),EngineeringDrawingandComputerGraphics,PearsonEducation
3. Agrawal B. & Agrawal C.M.(2012),Engineering Graphics, TMH Publication
4. Narayana, K.L. &P Kannaiah(2008),Text book on Engineering Drawing, Scitech Publishers
5. Corresponding set of) CAD Software Theory and User Manuals

Course Outcomes: At the end of the course, the student will be able to

1. make a distinction between first angle projection and third angle projection of drawing.
2. draw hyperbola, parabola, Involutes and Cycloidal curves.
3. draw sections of solids including cylinders, cones, prisms and pyramids.
4. draw projections of lines, planes, solids and sections of solids.
5. draw orthographic projections of lines, planes, and solids.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1			1	1					
CO2	2	1				1	1					
CO3		2		2		2						1
CO4			1	2			1					
CO5		1		2		3						

EN 106 / EN 206 ENGLISH COMMUNICATION LAB

Instruction: 0(L) +3(Lab) /week Credits: 1.5 Assessment: 40 + 60

Listening Comprehension -Pronunciation, Intonation, Stress and Rhythm -Common Everyday Situations: Conversations and Dialogues -Communication at Workplace -Interviews -Formal Presentations

Reference/Text Books:

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. On Writing Well. William Zinsser. Harper Resource Book. 2001
4. Study Writing. LizHamp– Lyons and Ben Heasly. Cambridge Univ. Press. 2006
5. Communication Skills. Sanjay Kumar and Pushpalata. Oxford Univ. Press.2011
6.Exercises in Spoken English. PartsI-III.CIEFL, Hyderabad. Oxford Univ. Press

Course Outcomes:

The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2									

II Semester

Code	Category	Course Title	Scheme of Instruction (hr/Week) Lecture	Tutorial	Practical	Total Instruction	Credits
MA201	Basic Sci.	Mathematics – II	3	1	-	4	**4**
PY 202	Basic Sci	Engineering Physics	3	1	-	4	**4**
CS 203	Basic Engg	Programming for Problem Solving	2	1	-	3	**3**
CE 204	Basic Engg	Engineering Mechanics	3	1	-	4	**4**
ME 205	Basic Engg. Lab	Workshop / Manufacturing Practices	-	-	3	3	**1.5**
CS 206	Basic Engg Lab	Programming for Problem Solving Lab	-	-	3	3	**1.5**
CE 207	Audit	Environmental Science	4	-	-	4	**0**
		TOTAL	13	3	6	22	**18**

MA 201MATHEMATICS II

(II Semester - for all branches)

Instruction: 3(L) +1(T) /week Credits: 4 Assessment: 40 + 60

Unit I

Matrices: rank of a matrix-solution of system of linear equations-Eigen values, vectors –Canley- Hamilton theorem-quadratic forms-diagonalization.

Unit II

Vector Calculus: Gradient, Divergence, Curl of a vector and related properties-line, surface, volume integrals-Green's, Stokes's and Gauss Divergence theorems and its applications.

Unit III

Fourier Series: Fourier series-even and odd functions, periodic functions-half range sine and cosine series-harmonic analysis.

Unit IV

Special Functions I: Gamma and Beta functions-series solutions of differential equations-ordinary points.

Unit V

Special Functions II: Bessel function-recurrence formulae-generating function for $J_n(X)$-Lengender polynomials-recurrence formulae-generating function for $P_n(X)$ - Rodriguez's formula - orthogonality of Lengender polynomials.

Text/Reference Books

1. B S Grewal, Higher Engineering Mathematics, 40th Edition, Khanna Publications, 2007.
2. M K Venkataraman, Engineering Mathematics, National Publishing Company, Chennai.
3. B V Ramana, Higher Engineering Mathematics, 6th Reprint, Tata McGraw-Hill, 2008.
4. Bali and Iyengar, Engineering Mathematics, 6th Edition, Laxmi Publications, 2006.

Course Outcomes: At the end of the course, students will be able to

1. use ranks of matrices to decide whether the system of linear equations is consistent or not
2. use Cayley-Hamilton theorem to find inverses or powers of matrices.
3. use Eigen values and vectors to reduce Quadratic forms to normal form.
4. to analyze motion problems from real lines to curves and surfaces in 3-D and use tools such as divergence and curl of vector and gradient, directional derivatives that play significant roles in many applications.
5. use Green's theorem to evaluate line integrals along simple closed contours on the plane
6. use Stokes' theorem to give a physical interpretation of the curl of a vector field
7. use the divergence theorem to give a physical interpretation of the divergence of a vector field.
8. find the Fourier Series to represent a function as a series of constants times sine and cosine functions of different frequencies in order to observe periodic phenomenon.
9. Evaluate certain improper integrals to make them simple with introduction of Gamma and Beta functions.
10. study certain special functions that arise in solving certain ordinary differential equations to model many physical phenomena.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3	3		1			2		3	
CO2	2	3	3		3		1					2
CO3		1				2		2				
CO4	1	3		3				1				
CO5	3		3		2			2				
CO6												
CO7												
CO8												
CO9												

CO10												

PY 202ENGINEERING PHYSICS

Instruction: 3(L) +1(T) /week Credits: 4 Assessment: 40 + 60

UNIT I Wave Optics

Interference: Huygen`s Principle-Principle of Superposition-Interference of Light-Young`s double slit experiment- -Newton's Rings.

Diffraction: Fraunhofer Diffraction at a Single Slit and a Circular Aperture-Plane Diffraction grating –Resolving Power-Rayleigh`s Criterion-Resolving power of Grating and Microscope.

Lasers : Introduction – Spontaneous and Stimulated Emission of Radiation – Population Inversion – Types of Lasers – Ruby Laser – He-Ne Laser – Semiconductor Laser – Applications of Lasers.

UNIT II Mechanics of Rigid Body

Rigid Body-Rotational Motion and Kinematics Relations-Kinetic Energy and Angular Momentum of a Rotating Body-Equation of Motion of a Rigid body (Torque of a Rigid Body)-Combined Translation and Rotational Motion of a Rigid Body- Body Rolling on an inclined Plane.

Mechanics of Continuous Media

Elasticity, Stress and Strain- Hook`s Law and Behaviour of Wire Under Load- Elastic Constants- Relation Between Elastic Modulii-Types of Supports, Beams and Loads-Different types of Bending- Cantilever with an End Load. Ultrasonic Waves - Sound Absorption and Reverberation -Sabine Formula - Acoustics of Buildings.

UNIT III Electromagnetism and magnetic properties of Materials

Laws of Electrostatistics- Electric Current- Laws of Magnetism- Ampere`s, Faraday`s laws- Maxwells Equations – Polarization - Permeability and dielectric constant- Polar and non-polar Dielectrics, Clausius-Mossotti equation, Applications of Dielectrics.

Magnetization - Permeability and Susceptibility- Classification of Magnetic Materials, Ferromagnetism-Magnetic Domains and Hesteresis, Applications of ferromagnetic materials.

UNIT IV Quantum Mechanics

Wave – Particle duality – de Broglie Concept of Matter Waves – Properties of Matter Waves – Davison and Germer Experiment – G.P.Thomson Experiment – Heisenberg's Uncertainty Principle – Schrödinger's Time Independent and Time Dependent Wave equation – Significance of Wave

Function – Electron in an Infinite Square Potential Well – Probability Densities and Energy Levels.

UNIT V NanoPhysics and Nanotechnology

Introduction to Nanomaterials –Properties: Optical Properties – Quantum Confinement – Electrical properties. Synthesis of Nanomaterials: Ball milling, Arc deposition method – Chemical Vapour Deposition-

Pulsed laser deposition. Characteristics of C^{60} (Zero dimensional), Carbon Nanotubes (One Dimensional) and Graphene(Two Dimensional). Applications of Nanomaterials.

Text Books / Reference Books:

1. R.K.Gaur and S.L.Gupta ``Engineering Physics" Sultan and Chand Pub., New Delhi
2. S.L.Gupta and SanjeevGupta`UnifiedPhysics`Vol.I Jai PrakashNath& Co., Meerut.
3. HitendraK.Malik and A.K.Singh ``Engineering Physics" TataMCGraw Hill Education Pvt.Ltd., New Delhi
4. M.N.Avadhanulu and P.G.Kshirsagar ``A Textbook of Engineering Physics`` S.Chand and Company Pvt.Ltd., New Delhi
5. B.L Theraja, "Modern physics", S.Chand& Company.
6. V. Raghavan "Material Science", Tata McGraw Hill Publications.
7. M.S.RamachandraRao and Shubra Singh, ``Nanoscience and Nanotechnology`` Wiley India Pvt.Ltd, New Delhi

Course Outcomes: At the end of the course, students will be able to

1. Develop appropriate competence and working knowledge of laws of modern Physics in understanding advanced technical engineering courses
2. understand the quantum mechanics and ultimately the quantum behavior of charged particles when they are in motion.
3. identify and apply appropriate analytical and mathematical tools of Physics in solving Engineering problems
4. apply the basic principles of Mechanics of rigid body and continuous media and their applications understand the principles in electrostatics and electromagnetics and magnetic properties of materials.
5. understand size depended properties of nano-dimensional materials and their effective utilization in making nano- and micro-devices for further microminiaturization of electronic devices.
6. think and participate deeply, creatively, and analytically in emerging areas of engineering technology.
7. Learnthe basics of instrumentation, design of laboratory techniques, measurement, data acquisition, interpretation, and analysis.
8. provide multidisciplinary experiences throughout the curriculum.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2									
CO2	2		2	2								
CO3		1		2	2							
CO4			2	2	3							

CO5		1	1	2								
CO6												
CO7												
CO8												

CS203 PROGRAMMING FOR PROBLEM SOLVING

Instruction: 3(L) +1(T) /week **Credits: 4** **Assessment: 40 + 60**

Course Objectives:

1. To acquire problem solving skills
2. To be able to develop flowcharts and algorithms for the given problem
3. To learn how to write modular programs in C
4. To enable to use arrays, pointers, strings and structures in solving problems.
5. To explain the difference between object-oriented programming and procedural programming.
6. To understand principles of object-oriented programming.

UNIT-I

Problem Solving : Problem solving techniques, Computer as a problem solving tool, Programming Languages – Machine Language, Assembly Language, Low and High-Level Languages, Procedural and Object-Oriented Languages. Algorithm definition, Features, Criteria, Flowchart definition, Basic symbols, Sample flowcharts, Problem solving aspects, Efficiency of algorithms.

Basics of C: Structure of a C program, C tokens, Keywords, Identifiers, Basic data types and sizes, Constants, Variables, Operators in C, Operator Precedence and Associativity, Expressions, Type conversions, Basic input/output statement, Sample programs.

UNIT-II

Conditional Statements: Selection statements, Decision making within a program, Simple if statement, if-else statement, Nested if-else, if-else ladder and switch-case. Iterative statements: while-loop, do-while loop, for loop, Nested loops, Infinite loops, goto, break and continue statements, Sample programs.

Functions: Introduction to modular programming and functions, Basics, Standard Library of C functions, Prototype of a function, Parameter passing, User defined functions, Recursive functions, Passing arguments to a function: Call by reference, Call by value, Storage Classes in a single source file, Scope rules, Header files, C Pre-processor.

UNIT-III

Arrays: Introduction to arrays, Definition, Declaration, Storing elements, Accessing elements, One dimensional arrays: Array manipulation; Searching, Insertion, Deletion of an element from an array, Two dimensional arrays, Addition/Multiplication of two matrices, Transpose of a square matrix, Passing array to functions, String fundamentals, String manipulations, Standard library string functions.

Pointers: Definition of pointer, pointer type declaration, pointer assignment, pointer initialization, Pointer arithmetic, Functions and Pointers, Dangling memory, Character pointers and functions, Pointers to pointers, Arrays and Pointers, Pointer arrays, Pointers and structures, Dynamic memory management functions.

UNIT-IV

Structures: Structures declaration, Structure variables, Initialization of structures, Accessing structures, Nested structures, Arrays of structures, Structures containing arrays, Structures and functions, Pointers to structures, Self-referential structures, Unions, Typedef, Bit-fields.

File Processing: Concept of Files, Text files and binary files, File opening in various modes and closing of a file, Reading from a file, Writing onto a file.

UNIT V

Introduction to Object-Oriented Programming (OOP): Need for OOP, Principles of OOP, Basics of C++ Programming, Operator Overloading, Function Overloading, Inheritance: Derived classes, Protected access specifier, Derived class constructors, Overriding member functions, Class hierarchies, Public and Private inheritance, Multiple inheritance.

Course Outcomes: At the end of the course, student will be able to

1. Develop and test programs in C and correct syntax and logical errors.
2. Implement conditional branching, iteration and recursion.
3. Decompose a problem into functions and synthesize a complete program.
4. Use arrays, pointers, strings and structures to formulate algorithms and programs
5. Use files to perform read and write operations.
6. Handle programming assignments based on class,abstraction, encapsulation, overloading and inheritance.

Text Books

1. Ashok N Kamthane, Amit Ashok Kamthane, Programming in C, 3rd Edition, Pearson Education, 2019.
2. Scheldt H, C: The Complete Reference, 4th Edition, Tata McGraw-Hill, 2002.
3. R.G. Dromey, How to solve it by Computer, Pearson Education, 2019.
4. Hanly J R &Koffman E.B, “Problem Solving and Program design in C”, Pearson Education, 2019.
5. Herbert Schildt,The Complete Reference C++, 4th Edition, Tata McGraw-Hill.

Reference Books

1. C Programming-A Problem Solving Approach, Forouzan, Gilberg, Cengage.
2. Programming with C, Bichkar, Universities Press.
3. Programming in C, ReemaThareja, OXFORD.
4. C by Example, Noel Kalicharan, Cambridge.
5. The C++ Programming Language, Bjarne Stroustrup, 3rd Edition, Pearson Education.
6. Problem solving with C++: The Object of Programming, 9th Edition, Walter Savitch, Pearson Education.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1		3			2			2		2
CO2	2	3	2		3					2		
CO3		2	1								3	
CO4		3										
CO5			3									
CO6												

CE 204 ENGINEERING MECHANICS

Instruction: 3(L) +1(T) /week **Credits: 4** **Assessment: 40 + 60**

UNIT I

STATICS : Basic concepts – System of force, Concurrent and non-concurrent coplanar and non- coplanar forces – Resultant – Moment of force and its application – Couples and resultant of force systems – Equilibrium of systems of forces – Free body diagrams, Equations of equilibrium of coplanar systems and spatial systems.

UNIT II

Analysis of plane trusses: Types of supports – Types of trusses – Analysis of trusses using method of joints and method of sections.

UNIT III

CENTRE OF GRAVITY AND MOMENTS OF INERTIA: Theory of Pappus – Centroids of composite figures – Areas of gravity of bodies – Moment of inertia – Parallel and perpendicular axis theorems – Moments of inertia of composite areas (rolled and built up sections) – Radius of gyration of areas.

UNIT IV

SIMPLE STRESES AND STRAINS : Elasticity and plasticity – Types of stresses and strains – Hooke's law – Stress-strain diagram for mild steel – Working stress – Factor of safety.

Lateral strain – Poisson's ratio and volumetric strain – Elastic moduli and relationship between elastic constants – Bars of varying section – Composite bars – Temperature stresses.

UNIT V

STRAIN ENERGY: Gradual, sudden and impact loading – Endurance limit principles of virtual work and its applications.

TEXTBOOKS:

1. Ghose D.N. – Applied Mechanics and Strength of Materials.
2. Timoshenko & Young – Engineering Mechanics.
3. Junarkar SB – Mechanics of Structures – Vol. I.
4. Junarkar SB – Elements of Applied Mechanics.

Course Outcomes: At the end of the course, student will be able to

1. apply the basic knowledge of force system.
2. know the types of supports occur in civil engineering structures
3. know the geometrical properties of different cross sections.
4. understand different types of stresses and strains, elastic constants.
5. understand the behavior of different internal forces under different types of loading.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2		2			2		1		1	
CO2	2	2		1			1		1		1	
CO3	2	2		1					2		1	
CO4	1	2		2							1	
CO5		2			1		2					

ME 205 WORKSHOP/MANUFACTURING PRACTICE

(ME 105 for EEE, ECE & CSE) (ME

205 for ChE,CE & ME)

Instruction: 0(L) +3 (lab)/week Credits: 1.5 Assessment: 40 + 60

Workshop Practice: Five practices among

1. Machine shop 2.Fittingshop 3.Carpentry 4.Electrical wiring

5. Welding shop 6.Casting 7.Smithy 8.Plasticmoulding&GlassCutting

Examinations could involve the actual fabrication of simple components, utilizing one or

More of the techniques covered above.

Detailed Contents

1. ManufacturingMethods-casting,forming,machining,joining, advanced manufacturing methods
2. CNC machining, Additive manufacturing
3. Fitting operations & power tools.
4. Electrical &Electronics
5. Carpentry
6. Plastic moulding. Glass cutting

7. Metal casting.
8. Welding(arc welding & gas welding), brazing

The above course content is learnt by online videos/ppt presentations.

Text/ReferenceBooks:

1. HajraChoudhury S.K., HajraChoudhury A.K.andNirjharRoy S. K., Elements of Workshop Technology", Vol. I 2008and Vol. II 2010, Media promoters and Publishers private limited, Mumbai.
2. Kalpakjian S. and Steven S. Schmid ManufacturingFngineeringand Technology", 4th edition, PearsonEducationIndiaEdition,2002.
3. GowriP.Hariharanand A. SureshBabu, Manufacturing Technology–I" Pearson Education,2008.
4. Roy A. Lindberg, Processes and Materials of Manufacture",4th edition, Prentice Hall India,1998.
5. RaoP.N., "ManufacturingTechnology",Vol. I & II,TataMcGrawHillHouse, 2017

Laboratory Outcomes

- Upon completion of this laboratory course, students will be able to fabricate components with their own hands.

- They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
- By assembling different components, they will be able to produce small devices of their interest.

Course Outcomes : Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry to fabricatecomponents using different materials.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1		1		1	1						1

CS206 PROGRAMMING FOR PROBLEM SOLVING LAB

Instruction: 0(L) +3 (Lab)) /week Credits: 1.5 Assessment: 40 + 60

Course Objectives:

1. To provide exposure to problem-solving through programming
2. To train the student on the concepts of the C- Programming language

The following programs shall be developed and executed in Programming Language C.

1. Programs on conditional control constructs.
2. Programs on iterative statements (while, do-while, for).
3. Programs on recursive procedures
4. Programs on arrays, matrices (single and multi-dimensional arrays).
5. Programs using user defined functions, demonstrating parameter passing methods viz. call by value and call by reference.
6. Programs using different library functions viz. ctype.h, math.h, stdio.h, stdlib.h, string.h, conio.h and pre-processor directives.
7. Programs using pointers (int pointers, char pointers) and pointer arrays.
8. Programs on structures and unions
9. Programs on File Processing.
10. Programs on Pointers to structures and Self-referential structures

Course Outcomes: After Completion of this course the student would be able to

1. Develop the C code for the given algorithm.
2. Understand, debug and trace the execution of programs written in C language.

Reference Books:

1. Scheldt H, C: The Complete Reference, 4th Edition, Tata McGraw-Hill, 2002.
2. Hanly J R &Koffman E.B, "Problem Solving and Program design in C", Pearson Education, 2019.
3. R.G. Dromey, How to solve it by Computer, Pearson Education, 2019.
4. Behrouz A. Forouzan& Richard F. Gilberg, Computer Science: A Structured Programming Approach Using C, Third Edition, Cengage Learning

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3		2		1		2	1	
CO2	3	3			2			3		2		3

ENVIRONMENTAL SCIENCE

Instruction: 4(L) Credits: 0(Zero) Assessment: 40 + 60

UNIT I

Environmental Studies and Natural Resources

Definition, Scope and importance of Environment, Environmental studies, Need for public awareness

Components of Environment- Atmosphere, Hydrosphere, Lithosphere.

Renewable and **Non-Renewable Resources and associated problems**

Water resources: Use and over utilization of surface and ground water, floods, drought, conflicts over water, dam benefits and problems.

Forest resources: Use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

Land resources: Land as a resource, land degradation, Man induced landslides, soil erosion and desertification.

Mineral resources: Use and overexploitation, Environmental effects of extracting and using mineral resources, case studies.

Food resources: World food problems, changes caused agriculture and overgrazing, effects of modern agriculture, fertilizer – pesticide problems, water logging, salinity, Case studies.

Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.

Role of an individual in conservation of natural resources.

UNIT II

Ecosystem and Biodiversity

Ecosystem - Concept of an ecosystem, Structure and functions of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the following ecosystem.

(a) Forest ecosystem. (b) Grassland ecosystem

(c) Desert ecosystem. (d) Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its conservation:

Definition, genetic species and ecosystem diversity, Biogeographically classification of India.

Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, National and local levels, India as a mega-diversity nation.

Hot-spots of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man – wildlife conflicts, Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

UNIT – III

Environmental pollution and Global Effects

Definition, Causes, Effects, and control measures of (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban and industrial

wastes. Role of an individual in prevention of pollution.

Pollution case studies.

Disaster management: Floods, earthquakes, cyclone, landslides,

Tsunami. Climate change-Global warming, Acid rain, Ozone

depletion.

UNIT – IV

Environment Issues and Management

- Environment and Human health – Epidemic diseases, HIV/AIDS, Aviation Flue, Water Borne Diseases.
- Environmental Impact Assessment, Sustainable Development, Clean Production and Clean Development Mechanisms
- Environment Legislation: Environmental Protection Act, Water Act, Air Act, Wild Life Protection Act, Forest Conservation Act, Public Liability & Insurance Act, Issues involved in Enforcement of Environmental legislation.

UNIT – V

Social Issues and the Environment

- Population growth, Population Explosion, Population Control, Women and Child welfare.
- Urbanization, Industrialization, Development projects, Resettlement and Rehabilitation of people – Problems concerned, Case studies.
- Consumerism and Waste Products Conservation, Public Awareness, Water Conservation, Rain water harvesting, watershed management, Wasteland reclamation, Human Rights, Value education, Environmental ethics- Issues and possible solution.
- Role of information Technology in Environment and Human Health.

Text Books / Reference Books :

1. AnubhaKaushik& C P Kaushik, Environmental studies, New age International Publishers,

2008
2. Benny Joseph, Environmental studies, Tata McGraw-Hill Publishers, 2005
3. M Chandra Sekhar, Environmental Science, Hi-Tech Publishers, 2004
4. Keerthinarayana and Daniel Yesudian, Principles of Environmental Sciences and Engineering , Hi-Tech Publishers, 2005
5. AmalK.Datta, Introduction to Environmental Science and Engineering, Oxford & IBH Publishing Co.Pvt.Ltd, 2000
6. SanthoshkumarGarg,RajeshawriGarg and RajniGarg, Ecological and Environmental studies, Khanna publishers, 2006
7. Gilbert M, Introduction to Environmental Engineering and Science, Masters Publication by Prentice –Hall of India Private Ltd., 1991
8. William P Cunningham and Mary Ann Cunningham, Principles of Environmental Science, Tata McGraw Hill Publishing Co.Ltd, 2002

Course Outcomes:

At the end of the course, students will be able to

1. acquire knowledge in
    - diverse components of environment and natural resources
    - ecosystem and biodiversity & its conservation methods
    - population growth and human health
    - green technology
2. identify and resolve the issues related to sources of different types of pollutions
3. provide solutions to individuals, industries and government for sustainable development of natural resources
4. apply environmental ethics in protection of diversified ecosystems.

****

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	1	2	1	1	1		
CO2	2	2	2	1		1	1	1	2	1		
CO3	2	2	2	2	1	1	1	2	2	1		
CO4	2	2	2	1	2	1	1	1	1	1		

III Semester

Code	Category	Course Title	Scheme of Instruction (hr/Week) Lecture	Tutorial	Practical	Total Instruction	Credits
MA301B	Basic Sci. Course	Mathematics – III*(Common to all branches)*	3	-	-	3	3
CE302C	Professional Core Course	Strength of Materials	3	-	-	3	3
HS303C	Humanities and Social Science	Managerial Economics and Accountancy *(Common to all branches)*	3		-	3	3
CE304C	Professional Core Course	Surveying	3	-	-	3	3
CE305C	Professional Core Course	Building Materials and Construction Technology	3		-	3	3
CE306C	Professional Core Course	Engineering Geology	3	-	-	3	3
CE 307P	Professional Core Course Lab	Surveying Lab	-	-	3	3	1.5
CE 308P	Professional Core Course Lab	Materials Testing Lab	-	-	2	2	1
CE309S	Skill Oriented Course	Computer Skills	1	-	2	3	2
MC310A	Mandatory Course	Constitution of India*(Common to all branches)*	2	-	-	2	-
		TOTAL	***21***	**-**	***7***	***28***	**22.5**

MA 301B Mathematics – III

Instruction Hours/week : 3(L) **Credits :3**

Sessional Marks : 40 **Semester-end Examination Marks: 60**

Course Educational Objective (CEOs):

1. To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering
2. To provide an overview of probability and statistics to engineers

UNIT I

Complex analysis - I: Analytical functions - Cauchy-Riemann equations – Construction of Analytic functions- Complex integration - Cauchy's theorem - Integral formula - Evaluation of integrals.

UNIT II

Complex analysis - II: Taylor's and Laurent's' series- Transformations- Conformal mapping - Bilinear transformations - Transformation of 1/z, z^2, sin z and cos z.

UNIT III

Complex analysis –III: Singularities - Poles - Residues - Residue theorem – Contour integration- Evaluation of real integrals

UNIT IV

Partial differential equations - I : Formation of differential equations - Classification - First order linear partial differential equations – Lagrange's' linear equation - Method of multipliers - first order non-linear partial differential equations - Charpits method.

UNIT V

Partial differential equations - II: Method of separation of variables - One dimensional wave equation - Heat equation – Laplace's equation.

Text Books:

1. Grewal B S, Higher Engineering Mathematics, 40th Edition, Khanna Publications, 2007.
2. Venkataraman M K, Engineering Mathematics, Vol. I & II, National Publishing Company, 1993.
3. Venkataraman M K, Engineering Mathematics, National Publishing Company, 1995.
4. Grewal B S, Engineering Mathematics, 13th Edition, Khanna Publications.
5. Kreyszig E, Advanced Engineering Mathematics, 8th edition, Wiley, 1998.

Course Outcomes (COs):

At the end of the course students will be able to

1. Solve field problems in engineering involving PDEs.
2. Formulate and solve problems involving random variables and apply statistical methods for analysing experimental data.

* * * * *

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1		1	1					1	1	
CO2	2	2		1	1					1	1	

CE 302C STRENGTH OF MATERIALS

Instruction Hours/week : 3(L) **Credits :3**
Sessional Marks : 40 **Semester-end Examination Marks:60**

Course Educational Objective (CEOs):

1. To acquire the knowledge about behavior of members subjected to various types of forces on the members.
2. To impart procedure for drawing shear force and bending moment diagrams for beams.
3. To make the student able to analyze flexural stresses in beams due to.
4. To enable the student to apply the concepts of strength of materials in engineering applications and design problems.

UNIT I

SHEAR FORCE AND BENDING MOMENT:

Definition of beam - Types of beams - Concept of shear force and bending moment - S.F and B.M diagrams for

cantilever, simply supported and overhanging beams subjected to point loads, u.d.l, uniformly varying loads and combination of these loads - Point of contra flexure - Relation between S.F, B.M and rate of loading at a section of a beam.

UNIT II

FLEXURAL STRESSES AND SHEAR STRESSES:

Theory of simple bending - Distribution of flexural stresses and shear stresses - Resilience due to flexure and shear. Principal stresses and principal strains - Mohr's circle of stresses.

UNIT III

COMBINED DIRECT AND BENDING STRESSES:

Stresses under the combined action of direct loading and B.M - Core of a section - Circular, rectangular and triangular (solid and hollow) - Determination of stresses in the case of chimneys, retaining walls and dams.

UNIT IV

COLUMNS AND STRUTS:

Introduction – classification of columns – Axially loaded compression members – Euler's crippling load theory – derivation of Euler's critical load formulae for various end conditions – Equivalent length – Slenderness ratio – Euler's critical stress – Limitations of Euler's theory – Rankine – Gordon formula – eccentric loading and Secant formula – Prof. Perry's formula.

UNIT V

CYLINDERS:

Thin cylinders subjected to internal fluid pressure - Thick cylinders under internal and external pressure - Compound cylinders.

TEXT BOOKS:

1) Mechanics of Structures Vol.I & Vol.II by S.B.Junnarkar.
2) Analysis of Structures by Vazirani & Ratwani.
3) Strength of Materials Vol.I & Vol.II by Timoshenko.
4) Strength of Materials by Andrew Pytal and Ferdinand L.Singer (Longman).

REFERENCES:

1) Engineering Mechanics by Egor. P. Popov.

Course Outcomes (COs):

After completion of the course the student will be able to:

1) Develop shear force and bending moment diagrams for different load cases.

2) Compute the flexural stresses for different load cases and different cross-sections.

* * * * *

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2		1				2	2	2	1
CO2	2	1	2	1	1				2	2	2	1

HS 303C MANAGERIAL ECONOMICS AND ACCOUNTANCY

Instruction Hours/week : 3(L) **Credits :3**

Sessional Marks : 40 **Semester-end Examination Marks :60**

Course Educational Objective (CEOs):

1. To learn the fundamental concepts of economics and analysis methods.
2. To study depreciation methods and inflation process and trade policies.
3. To acquire knowledge in basic concepts of accounting, principles.

4. To learn the techniques for preparing cost sheet.

Unit -I

Introduction to Engineering Economics, Fundamental concepts, Time value of money, Cash flow and Time Diagrams, choosing between alternative investment proposals, Methods of Economic analysis (pay back, ARR, NPV, IRR and B/C ratio), The effect of borrowing on investment, Equity vs Debt Financing, concept of leverage, Income tax leverage.

Unit -II

Depreciation and methods of calculating depreciation (straight line, sum of the years digit method, Declining balance method, Annuity method, Sinking fund method), National income accounting Methods of estimation, Various concepts of National Income, Significance of National income Estimation and its limitations.

Unit -III

Inflation: Definition, Process and Theories of inflation and Measure of control. New Economic Policy 1991(Industrial Policy, Trade Policy, Fiscal Policy), Impact on Industry.

Unit -IV

Accounting Principles, procedure, Double entry system, Journal, ledger, Trial balance, Cashbook, preparation of Trading and Profit and Loss account, Balance sheet.

Unit -V

Cost Accounting: Introduction, Classification of costs, Methods of costing, Techniques of costing, Cost sheet and preparation of cost sheet, Break-even Analysis, Meaning and its application, Limitation.

TEXT BOOKS:

1. Henry Malcom Steiner, Engineering Economics Principles, 2nd Edition, McGraw Hill Education, 1996.
2. Dewett. K.K., Modern Economic Theory, Sultan Chand and Co., 2006.
3. A.N. Agarwal, Indian Economy, Wiley Eastern Limited, New Delhi.
4. Jain and Narang, Accounting Part-I, Kalyani Publishers, 2011.
5. Arora, M.N. Cost Accounting: Principles and Practice, 12th Edition,Vikas Publication, 2012.

Course Outcomes (COs): After the completion of the course the student will be able to:

1. Understand Macro Economic environment of the business and its impact on enterprise.
2. Identify various cost elements of the product and its effect on decision making.
3. Understand the concepts of financial management and smart investment.
4. Prepare the Accounting records and interpret the data for Managerial Decisions.

* * * * *

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			1			2					1	
CO2			1			2					1	
CO3			1			2					1	
CO4			1			2					1	

CE 304C SURVEYING

Instruction Hours/week : 3(L) **Credits :3**

Sessional Marks : 40 **Semester-end Examination Marks :60**

Course Educational Objectives (CEOs):

1. Highlight the purpose of surveying in civil engineering construction,
2. Explain different types of curves, their requirement and curve setting.
3. Formulate survey observations and perform calculations
4. Train on utilization of surveying instruments like EDM, Total station and GPS.

UNIT – I

Introduction and Basic Concepts: Introduction, Objectives, classification and principles of surveying, Scales, Shrinkage of Map, Conventional symbols and Code of Signals, Surveying accessories, phases of surveying.

Measurement of Distances and Directions

Linear distances- Approximate methods, Direct Methods- Chains- Tapes, ranging, Tape corrections, indirect methods- optical methods- E.D.M. method.

Prismatic Compass- Bearings, included angles, Local Attraction, Magnetic Declination and dip.

UNIT - II

Levelling and Contouring

Leveling- Basics definitions, types of levels and levelling staves, temporary adjustments, methods of levelling, booking and Determination of levels- HI Method-Rise and Fall method, Effect of Curvature of Earth and Refraction.

Contouring- Characteristics and uses of Contours, Direct & Indirect methods of contour surveying, interpolation and sketching of Contours.

Computation of Areas and Volumes

Areas - Determination of areas consisting of irregular boundary and regular boundary (coordinates, MDM, DMD methods), Planimeter.

Volumes - Computation of areas for level section and two level sections with and without transverse slopes, determination of volume of earth work in cutting and embankments, volume of borrow pits, capacity of reservoirs.

UNIT - III

Theodolite Surveying: Types of Theodolites, Fundamental Lines, temporary adjustments, measurement of horizontal angle by repetition method and reiteration method, measurement of vertical Angle, Trigonometrical levelling when base is accessible and inaccessible.

Traversing: Methods of traversing, traverse computations and adjustments, Gale's traverse table, Omitted measurements.

UNIT - IV

Tacheometric Surveying: Principles of Tacheometry, stadia and tangential methods of Tacheometry.

Curves: Types of curves and their necessity, elements of simple curve, setting out of simple Curves, Introduction to compound curves. Elements of Reverse curve - Transition curve – length of curve – Elements of transition curve - Vertical curves.

UNIT - V
MODERN SURVEYING INSTRUMENTS:

Modern Field Survey Systems: Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories –Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements, Applications of GPS.

TEXT BOOKS:

1. Surveying and levelling by R. Subramanian, Oxford university press, New Delhi.
2. Chandra A M, "Higher Surveying", New age International Pvt. Ltd., Publishers, New Delhi, 2002.
3. Hoffman. B, H. Lichtenegga and J. Collins, Global Positioning System - Theory and Practice, Springer -Verlag Publishers, 2001.

REFERENCES:

1. Arthur R Benton and Philip J Taety, Elements of Plane Surveying, McGraw Hill – 2000.
2. Arora K R "Surveying Vol 1, 2 & 3), Standard Book House, Delhi, 2004.
3. Surveying (Vol – 1, 2 & 3), by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain - Laxmi Publications (P) ltd., New Delhi.
4. Chandra A M, "Plane Surveying", New Age International Pvt. Ltd., New Delhi, 2002.
5. Surveying by Bhavikatti; Vikas publishing house ltd.
6. Duggal S K, "Surveying (Vol – 1 & 2), Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2004.
7. Surveying and leveling by R. Agor Khanna Publishers 2015.

Course Outcomes (COs):

After completion of the course the student will be able to:

- Identify data collection methods and prepare field notes.
- Measure and layout elevations and relative position of points, understand plans and field notes.
- Ability to design, set out curves and use modern equipment.
- Calculate angles, distances, levels, estimate measurement errors and apply corrections.
- Interpret survey data and compute areas and volumes.

* * * * *

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1		1					1	
CO2	2	1	2	1		1		1			1	
CO3	2	2	1	1		2		1			1	
CO4	2	2	1	1		2		1			1	
CO5	2	2	1	1		2		1			1	

CE 305C BUILDING MATERIALS AND CONSTRUCTION

Instruction Hours/Week: 3(L) Credits : 3
Sessional Marks : 40 **Semester-end Examination Marks**: 60

Course Educational Objective (CEOs):

- To learn and understand the manufacturing, physical and mechanical properties of various construction materials and their testing procedures.
- To study the basic building components.
- To learn the methods to be followed in constructing various components of a building.

UNIT-I
STONES-BRICKS
Stone as building material-Selection of stones for construction-Tests on stones-Qualities of a good building stone-Deterioration of stones-Preservation of stones.

Bricks-composition of good brick earth-Manufacture of bricks-Classification of bricks-Tests for bricks-Absorption, Crushing strength, Hardness, presence of soluble salts, shape and size, soundness, structure-Uses of bricks-Refractories.

UNIT-II
CEMENT-AGGREGATES
Cement ingredients-Setting action of cement-Manufacturing process of ordinary cement
-Types of cement – Field and laboratory tests for cement-storage and uses of cement.

Aggregates-Qualities-classification of aggregates-Testing of Aggregates—Grading of aggregates-classification of sand-Bulking of sand- properties of good sand.

UNIT-III
TIMBER AND OTHER MATERIALS
Timber-Qualities of good timber- Market forms-Industrial timber, Plywood, Veneer-.
Steel -Market forms of steel. Aluminum -properties , alloys of aluminium.

UNIT-IV
CONSTRUCTION ELEMENTS
Types of foundations, Stone Masonry-joints in stone masonry, classification of stone masonry. Brick Masonry-Bonds in brick masonry, types of brick masonry. Lintels- Types of lintels. Roofs and its types. Flooring -types of flooring, timber floors, composite floors. Damp proofing- meaning, causes, effects, materials used for damp proofing, methods of damp proofing.

UNIT-V
OTHER ELEMENTS
Pointing-objects, mortar for pointing, method of pointing, types of pointing. Plastering-requirements of good plaster, methods of plastering. Painting-types of paints, painting on different surfaces failure of paint, defects in

painting. Varnishing- characteristics of ideal varnish, ingredients, types, process of varnishing. Distempering- properties, ingredients of a distemper, process of distempering.

Thermal Insulation - insulating materials, thermal insulation of exposed doors, windows, exposed roofs and exposed walls. Acoustics-definition, types of absorbent materials, conditions for good acoustics, methods of sound insulation.

TEXTBOOKS:

1. Sushil Kumar "Building Materials and construction", 20th edition, reprint 2015,StandardPublishers
2. Dr. B. C. Punmia, Ashok kumar Jain, Arun Kumar Jain, "Building Construction, Laxmi Publications (P) ltd., New Delhi.
3. Rangwala S. C. "Engineering Materials", Charotar Publishing House, India.

REFERENCES:

1. S. K. Duggal, "Building Materials", (Fourth Edition)New Age International (P) Limited, 2016 National Building Code(NBC) of India
2. P C Vergese, "Building Materials", PHI Learning Pvt.Ltd
3. Building Materials and Components, CBRI, 1990,India
4. Jagadish. K.S, "Alternative Building Materials Technology", New Age International,2007.
5. M. S. Shetty, "Concrete Technology", S. Chand & Co. New Delhi.

Course Outcomes (COs):

After completion of the course the student will able to:

- Explain the manufacturing, physical and mechanical properties of various construction materials and their testing procedures.
- Describe the basic building components.
- Apply the methods to be followed in constructing various components of a building.

* * * * *

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1		1	1		1	2	1	2	1	1	1
CO2	1		1	1		1	2		2	1	1	1
CO3	2	1	1	1		1	2	1	2	1	2	1

CE 306C ENGINEERING GEOLOGY

Instruction Hours/Week : 3(L) Credits : 2

Sessional Marks : 40 **Semester-end Examination Marks**: 60

Course Educational Objective (CEOs):

1. To learn various geological parameters.
2. To study characteristics of various minerals and their Identification.
3. To study the formation and features of rocks and their Identification .
4. To learn elements of geological structures.
5. To acquire knowledge in preliminary causes for landslides and earth quakes.

UNIT – I

Introduction to geology and its various branches -Role of Earth Sciences in Civil Engineering Operations, Processes acting at the surface of the earth - Volcanism, Geological action of wind, glaciers, rivers and oceans - Application of Earth Science in Civil Engineering Practices, Understanding the earth, internal structure and composition. Weathering, erosion and denudations process on earth material and natural agencies, Geological work of wind, river underground water and glaciers.

UNIT – II

Mineralogy: Mineral properties, composition and their use in the manufacture of construction materials – Quartz Group; Feldspar Group; Kaolin; Asbestos; Carbonate Group ; Gypsum; Mica Group; Ore minerals - Iron ores; pyrite; Chlorite. Study of minerals like Garnet, Olivine, Hornblende, Augite, Calcite, Talc, Kyanite, Bauxite and Clay minerals.

UNIT – III

Petrology: Origin and formation of rocks - Classification of rocks - Igneous, Sedimentary and Metamorphic rocks - Their textures and structures -Study of rocks like Granite, Gabbro, Dolerite, Basalt, Breccia, Conglomorate, Sand stone, Shale, Limestone, Laterite, Quartzite, Schist, Gneiss, Marble, Slate. Definition of rock - Rock forming processes - Geological classification of rocks - Megascopic study, Chemical and Mineralogical Composition of rock.

UNIT – IV

Structural Geology: Elements of structural geology like strike, dip, outcrop. Study of folds, joints, faults and their importance in civil engineering works. Dykes and sills, common structures and textures - Out crop, strike and dip study of common geological structures associating with the rocks such as folds, faults unconformities, and joints – their important types. Their importance insitu and drift soils, common types of soils, their origin and occurrence in India.

UNIT – V

Geology of dams, reservoirs, tunnels landslides and rock falls. Earthquakes. Groundwater exploration. Rock as construction materials. Site selection for dams and tunnels – analysis of failures in dams and tunnels - Seismic zones of India - Earth quakes, their causes and effects. Seismic waves, Richter scale. Landslides - causes and effects; Tsunami –causes and effects.

TEXT BOOKS:

1. A text book of geology By Mukharjee.P.K.
2. A Text Book of Engineering Geology - N.Chennakesavulu.
3. Engineering and general Geology by Parbin Singh
4. Engineering Geology by R.E.Goodman

REFERENCES:

1. Principles of Engineering geology and Geotechnics By Krynine & Judd
2. Geology for Engineers by Blyth & de freitaus
3. Fundamental of Engineering Geology by F.H.Bell.

Course Outcomes (COs):

After completion of the course the student will be able to:

1. To apply the geological knowledge to Civil Engineering Constructions, at different stages. The kind of study exposes the geological draw backs, if any.
2. To help the site engineers to take suitable precautionary measures to overcome the drawbacks but also to take advantage of the site geology findings wherever possible.
3. To take precautionary measures in civil engineering constructions based on geological parameters.

* * * * *

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2			1	1		1			1		
CO2	1				1		1					
CO3	1				1		1					

CE 307P SURVEYING LAB

Instruction Hours/week : 3 (P) **Credits : 1.5**

Sessional Marks : 40 **Semester-end Examination Marks: 60**

Course Educational Objective (CEOs):

1. To apply the possess knowledge about survey field techniques
2. To apply the possess knowledge about traverse survey
3. To determine distances, areas of polygons
4. To gain knowledge of modern field measurement tools and techniques

EXERCISE – 1

Measurement of distance by chain, Tape and Area of a polygon by cross staff survey

EXERCISE – 2

Compass traversing and adjustment of closing error by Bowditch method (Graphical method)

EXERCISE – 3

Plane table survey; finding the area of a given boundary

EXERCISE – 4

Fly levelling: Height of the instrument method and rise and fall method.

EXERCISE – 5

Fly levelling; Longitudinal Section and Cross sections of a given road profile.

EXERCISE – 6

Theodolite Survey: Determining the Horizontal and Vertical Angles Finding the distance between two inaccessible points.

EXERCISE – 7

Tachometric survey: Heights and distance problems using tachometric principles.

EXERCISE – 8

Set out simple curve using Perpendicular offsets from long chord and Rankine's deflection angles method.

EXERCISE – 9

Total Station: Determination of area using total station.

EXERCISE – 10

Total Station: Determination of Remote height.

Course Outcomes (COs):

After completion of the course the student will have:

1. Ability to use the techniques, skill and surveying equipment for engineering practice.
2. Ability to apply mathematics concepts in the field of surveying.
3. Ability to develop an understanding of modern surveying equipment

* * * * *

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2			1	1		1			1		
CO2	1				1		1					
CO3	1				1		1					

CE 308P MATERIAL TESTING LAB

Instruction Hours/Week : 2(P) **Credits** : 1
Sessional Marks : 40 **Semester-end Examination Marks**: 60

Course Educational Objective (CEOs):

1. To make student understand the fundamental modes of loading of the structures
2. To train student in methods for determining mechanical properties of materials.

LIST OF EXPERIMENTS

1. Tension and Torsion Test on Mild Steel bar and HYSD bar
2. (a) Deflection Test on Simply Supported Beam
   (b) Charpy Impact Test
3. (a) Deflection Test on Fixed Beam
   (b) Izod Impact Test
4. (a) Compression Test on Wood
   (b) Shear Test on Wood
5. (a) Test on Closed coil Helical Spring
   (b) Bending Test on Carriage Spring
6. (a) Deflection Test on beam under Uniform Bending
   (b) Bending Test on R.S. Joist
7. Sieve Analysis of coarse and fine aggregates
8. Bulking of Sand by Volume and Weight methods
9. Normal consistency, Initial and Final Setting Times of Cement
10. Tests on concrete
    a) Slump Test
    b) Compressive Strength of Concrete Cubes
    c) Compaction Factor Test
    d) Compressive Strength of Concrete Cylinders
11. (a) Specific gravity & Water absorption of Coarse aggregate
    (b) Specific gravity of Cement
12. Water absorption and Compressive Strength of Bricks

Course Outcomes (COs):

After completion of the course the student will be able to

1. Determine the properties of different building construction materials.
2. Analyse the behaviour of different construction materials.

* * *

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1								1		
CO2	2	1								1		

CE 309S COMPUTER SKILLS

Instruction Hours/week: 2 (P) **Credits :1**

Sessional Marks : 40 **Semester-end Examination Marks: 60**

Course Educational Objectives (CEOs):

1. To learn and use MSWORD.
2. To learn and use MSEXCEL,MSPOWERPOINT
3. To learn and browse the INTERNET and EMAIL

EXERCISE – 1:
MS WORD: Text Basics, Text Formatting and saving file, working with Objects

EXERCISE – 2 :
MS WORD: Header & Footers, Working with bullets and numbered lists, Tables

EXERCISE –3:
MS WORD: Styles and Content, Merging Documents, Sharing and Maintaining Document

EXERCISE –4 :
MS WORD: Sharing and Maintaining Document, : Proofing the document, Printing

EXERCISE –5:
MS EXCEL: Introduction to Excel, Formatting excel work book

EXERCISE –6
MS EXCEL: Perform Calculations with Functions, Sort and Filter Data with Excel

EXERCISE – 7:
MS EXCEL: Create Effective Charts to Present Data Visually, Analyze Data Using PivotTables and Pivot Charts, Protecting and Sharing the work book

EXERCISE – 8:
MS EXCEL: Use Macros to Automate Tasks, Proofing and Printing

EXERCISE – 9:
MS POWER POINT: Setting Up PowerPoint Environment, Creating slides and applying themes, Working with bullets and numbering, Working with Objects, Slide show option and print

EXERCISE – 10:
INTERNET AND EMAIL: What is Internet, Receiving Incoming Messages , Sending Outgoing Messages, Email addressing , Email attachments, Browsing, Search engines , Text chatting, Job Searching.

COURSE OUTCOMES (COs):

After completion of the course the student will be able to:

1. Use MS WORD, MS EXCEL AND POWER POINT in any civil engineering project works and for personal works.

* * * * *

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2								1	1

MC310A CONSTITUTION OF INDIA

Instruction Hours/Week : 2(L) **Credits : -**
Sessional Marks : 100 **End Semester Examinations Marks : -**

Course Educational Objectives(CEOs): Students will learn:

1. To Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Unit-I
History of Making of the Indian Constitution:
History **,**Drafting Committee, (Composition & Working)
Philosophy of the Indian Constitution: Preamble Salient Features

Unit-II
Contours of Constitutional Rights & Duties:

- Fundamental Rights
- Right to Equality
- Right to Freedom
- Right against Exploitation
- Right to Freedom of Religion
- Cultural and Educational Rights
- Right to Constitutional Remedies
- Directive Principles of State Policy
- Fundamental Duties.

Unit-III
Organs of Governance:

- Parliament
- Composition
- Qualifications and Disqualifications
- Powers and Functions
- Executive
- President
- Governor
- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications
- Powers and Functions

Unit-IV

Local Administration:

- District's Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.
- Pachayati raj: Introduction, PRI: Zila Pachayat.
- Elected officials and their roles, CEO Zila Pachayat: Position and role.
- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials,
- Importance of grass root democracy

Unit-V

Election Commission:

- Election Commission: Role and Functioning.
- Chief Election Commissioner and Election Commissioners.
- State Election Commission: Role and Functioning.
- Institute and Bodies for the welfare of SC/ST/OBC and women.

TEXT BOOKS/REFERENCES:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes(COs):

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

E-RESOURCES:

1. nptel.ac.in/courses/109104074/8

2. nptel.ac.in/courses/109104045/
3. nptel.ac.in/courses/101104065/
4. www.hss.iitb.ac.in/en/lecture-details
5. www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						2			2			
CO2						2			2			
CO3						2			2			
CO4						2			2			

* * * * *

IV Semester

Code	Category	Course Title	Scheme of Instruction (hr/Week) Lecture	Tutorial	Practical	Total Instruction	Credits
MA401C	Engineering Sci. Courses	Probability &Statistics *(Common to all branches)*	3	-	-	3	3
CE402C	Professional Core Courses	Concrete Technology and Construction Equipment	3	-	-	3	3
CE403C	Professional Core Courses	Fluid Mechanics and Hydraulic Machines	2	1	-	3	3
CE404C	Professional Core Courses	Structural Analysis	2	1	-	3	3
CE405C	Professional Core Courses	Environmental Engineering -1	3	-	-	3	3
CE406C	Professional Core Courses	Soil Mechanics	2	1	-	3	3
CE407P	Professional Core Lab	Fluid Mechanics and Hydraulic Machines Lab	-	-	3	3	1.5
CE408P	Professional Core Lab	Soil Mechanics Lab	-	-	2	2	1

CE409S	Skill Oriented Course *	Python Programming	1	-	2	3	2
CE410P	Professional Core Lab	Computer Aided Building Drawing	-	-	3	3	1.5
		TOTAL	**17**	**5**	**10**	**37**	**24**

MA 401C PROBABILITY & STATISTICS

Instruction Hours/Week: 3(L) **Credits: 3**
Sessional Marks : 40 **End Semester Examinations Marks: 60**

Course Educational Objective (CEOs)

The objective of this course is

1. To familiarize the students with numerical methods of solving the non-linear equations, interpolation, differentiation, integration, and ordinary differential equations.
2. To impart knowledge in basic concepts and few techniques in probability and statistics in relation to the engineering applications.

UNIT- I

SOLUTION TO ALGEBRAIC EQUATIONS: Solution of polynomial and transcendental equations: bisection method, Newton-Raphson method and Regula-Falsi method. finite differences, relation between operators, interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae.

UNIT- II

NUMERICAL DIFFERENTIATION AND INTEGRATION: Numerical Differentiation, numerical integration- trapezoidal rule and Simpson's 1/3rd and 3/8 rules. Ordinary differential equations-Taylor's series, Euler and modified Euler's methods. Runge-Kutta method of fourth order for solving first and second order equations.

UNIT -III

PROBABILITY : Probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem, random variables (discrete and continuous)**,** probability distribution: Binomial - Poisson approximation to the binomial distribution and normal distribution-their properties.

UNIT- IV

TESTING OF HYPOTHESIS: Formulation of null hypothesis, critical regions, level of significance. Large sample tests: test for single proportion, difference of proportions, test for single mean and difference of means.

UNIT -V

SMALL SAMPLE TESTS: Student t-distribution(single mean, two means and paired t-test), Testing of equality of variances (F-test), $\chi 2$ - test for goodness of fit, $\chi 2$ - test for independence of attributes.

Textbooks:

1. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2/e, Reprint 2012.

References

1. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9/e, John Wiley & Sons, 2006.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

Course Outcomes:

At the end of the course students will be able to

- evaluate approximating the roots of polynomial and transcendental equations by different algorithms
- Apply different algorithms for approximating the solutions of ordinary differential equations to its analytical computations
- apply discrete and continuous probability distributions
- design the components of a classical hypothesis test

infer the statistical inferential methods based on small and large sampling tests

--oOo—

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3										
CO2	2	3										
CO3	3	3	3									
CO4	2	3										

CE 402C CONCRETE TECHNOLOGY

Instruction Hours/Week : 3(L) **Credits : 3**
Sessional Marks : 40 **End Semester Examinations Marks : 60**

Course objectives:

1) Explain the functional role of ingredients of concrete and apply this knowledge to mix design philosophy
2) Develop fundamental knowledge in the fresh and hardened properties of concrete
3) Produce the testing methodology to evaluate the properties of concrete during fresh and hardened stage
4) Knowledge on the behaviour of concrete with response to stresses developed.
5) Knowledge on the special concretes And design a concrete mix which fulfils the required properties for fresh and hardened concrete

UNIT-I

CEMENTS AND AGGREGATES:

General, Manufacture of Portland cement by dry process, Approximate oxide composition limits of OPC, Bogue's compounds, heat liberation from a setting cement, structure of hydrated cement, water requirements for hydration.

TYPES OF CEMENTS: Ordinary Portland cement, Rapid hardening cement, Sulphate resisting cement, Slag cement, Quick setting cement, Super sulphated cement, Portland pozzolana cement, air entraining cement, coloured cement, expansive cement, High alumina cement.

AGGREGATES: Classification, source, size and shape texture and influence of texture on strength, specific gravity of aggregates, moisture in aggregates, bulking of fine aggregate, methods used for determination of moisture content of aggregates, grading of aggregates, sieve analysis, standard grading curve, grading limits of fine aggregates as per IS ; gap grading.

UNIT-II

WATER & ADMIXTURES: Quality of water for mixing concrete, Tolerable concentrations of some impurities in mixing water, permissible limit for solids as per IS456-2000, use of sea water for mixing concrete.

ADMIXTURES AND CONSTRUCTION CHEMICALS: General, plasticizers and super plasticizers – Dosage, mixing procedure, equipment, effect of super plasticizes on the properties of hardened concrete, Retardors, accelerators. Air-entraining admixtures, factors affecting amount of air-entrainment, effect of air-entrainment on the properties of concrete, fly ash, effect of fly ash on fresh and hardened concrete, high volume fly ash concrete, silica fume, available forms, effect of silica fume on compressive strength of concrete, construction chemicals for curing, construction chemicals for water proofing.

UNIT-III

FRESH CONCRETE:

Workability, factors affecting workability, slump test, Kelly ball test, V-B test, compaction factor test, segregation, bleeding, volume batching and weigh batching, hand mixing, machine mixing, mixing time, compaction of concrete, hand compaction, compaction by vibration, internal vibrator, form work vibrator, table vibrator, platform vibrator, surface vibrator.

UNIT-IV

HARDENED CONCRETE: General, water-cement ratio; gel/space ratio; gain of strength with age; maturity concept of concrete, effect of maximum size of aggregate on strength.

TEST ON HARDENED CONCRETE: Compression test; moulds and compacting; curing; failure of compression specimen; effect of height/diameter ration strength; flexural strength of concrete; tensile strength of concrete; non-destructive testing methods

ELASTICITY, CREEP AND SHRINKAGE: Elastic properties of aggregate, Factor's affecting modulus of elasticity, poisson's ratio, creep and factors affecting creep, shrinkage and factors affecting shrinkage.

DURABILITY OF CONCRETE: Factors contributing to cracks in concrete, sulphate attack and methods of controlling sulphate attack, chloride attack, corrosion of steel and its control.

CONSTRUCTION EQUIPMENT: Selection of equipment for earth work, concreting, material handling and erection of structures-Dewatering and pumping equipments

UNIT-V

SPECIAL CONCRETES AND CONCRETING METHODS: Fibre reinforced concrete; Fibres used, factors effecting properties, aspect ratio of fibres, orientation of fibres, workability, mixing, applications, current development in FRC.

NO-FINES CONCRETE: mix proportion, drying shrinkage, Thermal conductivity, applications.

Ferrocement: Casting techniques, hand plastering, semi-mechanized process, Centrifuging, guniting, applications.

LIGHT-WEIGHT CONCRETE: Natural and artificial light-weight aggregates, properties of common light-weight concretes. High performance concrete.

PROPORTIONING OF CONCRETE MIXES: Concept of mix design, variables in proportioning ,different methods of mix design, nominal mix and design mix, Indian standard method of mix design.

TEXT BOOK

1. Concrete Technology by M.S.Shetty, S.Chand & Company Pvt. Ltd., New Delhi

REFERENCE BOOKS

1. Properties of concrete by A.M.Neville, Longman Publishers
2. Concrete technology by M.L.Gambhir, Tata McGraw-Hill Publishing company Ltd., New Delhi.

Course Outcomes:

At the end of the course student is able to

- Understand various ingredients of concrete and their role.
- Examine knowledge on the fresh and hardened properties of concrete.
- Design concrete mixes using various methods.
- Perceive special concretes for accomplishing performance levels.

--oOo—

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				1		2			1	1		2
CO2	2	2	2	1					1	1	1	
CO3	2	2	2	1	2				1	1	1	
CO4	2		2	1					1		1	2

E403C FLUID MECHANICS AND HYDRAULIC MACHINES

Instruction Hours/Week : 2(L) +1(T) Credits : 3
Sessional Marks : 40 End Semester Examinations Marks: 60

Course Educational Objective (CEOs)

1. To understand the significance of fluid properties.
2. To apply the knowledge of fluid flow concepts and fundamental equations.
3. To solve the problems related to impacts of jets and flow measurements.
5. To apply the knowledge of laminar and turbulent flows.

6. To design the characteristics of turbines and pumps.

UNIT – I

FLUID PROPERTIES

Definition of a fluid –Density, Specific weight, Specific volume, Specific gravity – Viscosity – Bulk modulus of elasticity – Vapour pressure – Surface tension and capillarity- Pressure at a point – Absolute and gauge pressures

FLUID STATICS

Pascal's law – Pressure measurement – Manometers- Mechanical gauges – Hydrostatic pressure and force: horizontal, vertical and inclined planes, Curved surfaces.

UNIT – II

FLUID FLOW CONCEPTS

Flow characteristics – Velocity – Acceleration – Types of flow – Streamlines, Path lines, Streak lines – Stream function, Velocity potential, flow-net – Circulation and Vorticity.

FUNDAMENTAL EQUATIONS

Continuity equation – Energy Equation - Euler's equation of motion along a streamline – Bernoulli's equation – Applications of Bernoulli's Equation – Free jets and vortex flows.

UNIT III

IMPACTS OF JETS

Linear momentum equation - Impacts of jets on free and fixed moving vanes – Moment of momentum equation.

FLOW MEASUREMENT

Velocity measurement – Pitot tubes – Flow measurements: Flow through pipes- Venturi meter, Orifice meter and Nozzle meter- Flow through Channels: Weir and notches – Flow through tanks: Orifice and Mouth pieces.

UNIT IV

LAMINAR FLOW

Laminar flow through: circular pipes, annulus and parallel plates. Stoke's law, Measurement of viscosity.

TURBULENT FLOW

Reynolds experiment, Transition from laminar to turbulent flow, Definition of turbulence, scale and intensity, Causes of turbulence, Turbulent flow in pipes. Reynolds stresses, semi-empirical theories of turbulence, Prandtl's mixing length theory, universal velocity distribution equation. Resistance to flow of fluid in smooth and rough pipes,

UNIT V

HYDRAULIC TURBINES

Classifications of turbines – Pelton Wheel, Francis Turbine and Kaplan Turbine velocity triangles at inlet and outlet – work done and efficiency– Draft Tube theory- Specific Speed – Characteristic Curves .

CENTRIFUGAL PUMPS

Components – Working – Types – Workdone – Heads – Losses and Efficiencies – Specific Speed – Multi Stage Pumps – Performance Characteristic Curves – Net positive Suction Head (NPSH).

Course Outcomes (COs)

After completion of the course the student will be

1. Able to solve fluid flow problems using fundamental principles
2. Able to apply the knowledge of fluid flow concepts and fundamental equations for solving problems

3. Able to measure pressure, velocity and discharge, and apply the knowledge of impacts of jets related to real life problems.
4. Able to analyze the flow problems in laminar and turbulent flow conditions.
5. Able to analyze the characteristics of turbines and pumps.

TEXT BOOKS

1. Hydraulics and Fluid Mechanics including Hydraulic Machines by P.N. Modi and S.M. Seth – Twentieth edition 2015, Standard Book House , New Delhi.
2. Fluid Mechanics and Hydraulic Machines by R.K.Rajput - 2002 Publication, S.Chand & Company Ltd., New Delhi.
3. Fluid Mechanics and Hydraulic Machines by R.K.Bansal -Revised Ninth edition 2010, Laxmi Publications (P) Ltd., New Delhi.

REFERENCE BOOKS

1. Fluid Mechanics by Victor L. Streeter and E.Benjamin Wylie, Keith W. Bedford – Edition 2010, Tata Mc Graw Hill Education Private Limited, New Delhi.
2. Fluid Mechanics and Turbo machines by Madan Mohan Das. – First Edition 2009, PHI Learning Pvt.Ltd., New Delhi.

--oOo—

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	2	2					2	1	2
CO2	2	2	2	2	2		1			2	2	2
CO3	2	1	2	2	2					2	1	2
CO4	2	2	2	2	2		1			2	2	2
CO5	2	2	2	2	2		1			2	2	2

CE 404C STRUCTURAL ANALYSES

Instruction Hours/Week :2(L)+1(T) **Credits : 3**
Sessional Marks : 40 **End Semester Examinations Marks : 60**

Course Objectives

1) to teach the student with basic concepts for determination of principal stresses and strains in various structural elements.
2) to demonstrate analytical methods for determining strength & stiffness and assess stability of structural members.
3) to train the student compute shear stresses in different cross-sections and analyze failure mechanisms.

4) to make the student analyze circular shafts subjected to torsion
5) to make the student determine critical loads for columns with different end conditions.

UNIT- I

DEFLECTIONS: Relationship between curvature, slope and deflection - Differential equation for the elastic line of a beam - Slope and deflection of cantilevers and simply supported beams by integration method, moment area method and conjugate beam method. Uniform bending – slope, deflection and radius of curvature – Differential equation for elastic line of a beam – Double integration and Macaulay's methods. Determination of slope and deflection for cantilever and simply supported beams under point loads, U.D.L. uniformly varying load- Mohr's theorems – Moment area method – application to simply supported and overhanging beams- analysis of propped cantilever beams under UDL and point loads.

UNIT-II

TORSION OF CIRCULAR SHAFTS: Theory of pure torsion in solid and hollow circular shafts - Transmission of power - Combined bending, torsion and end thrust.

SPRINGS: Types of springs - Close and open coiled helical springs under axial loads and axial couple - springs in series and parallel - Carriage or leaf springs.

UNIT- III

INFLUENCE LINES AND MOVING LOADS:

Influence lines for reactions, BM and SF; Curves of maximum BM and SF for single, two and multiple loads, udl longer and shorter than span, enveloping parabolic and EUDL – forces in truss members.

UNIT- IV

ENERGY THEOREMS: Virtual work and energy principles - Maxwell's, Betti's theorems, Castigliano's first theorem and unit load method - Deflection of simple beams and pin-jointed trusses. Strain energy in linear elastic system, expression of strain energy due to axial load, bending moment and shear force. Introduction to finite element method for plane stress and plane strain.

UNIT- V

INDETERMINATE STRUCTURES: Indeterminate Structural Analysis – Determination of static and kinematic indeterminacies – Analysis of plane trusses with two degrees of internal and external indeterminacy - Castigliano's theorem–II – Lack of fit.

TEXT BOOKS:

1) Analysis of Structures Vol.I & II by V.N.Vazirani & M.N.Ratwani.

2) Intermediate Structural Analysis by Wang.

3) Mechanics of Structures Vol.II by S.B.Junarkar.

4. Structural Analysis by L.S.Negi & R.S.Jangid.

5) Theory of Structures - Vol.I by S.P.Gupta, G.S.Pandit & R.Gupta.

6) Fundamentals of Structural Analysis by Sujit Kumar Roy & Subrata Chakrabarty.

Course Outcomes:

On completion of the course, the student will be able to:

- Understand various engineering properties of materials
- Estimate magnitudes under combined loads in members and structures
- Determine shear stresses for different cross-sections.
- Determine deflection at any point on a beam under simple or combined loads
- Apply failure criteria to implement in design of structural members.
- Analyze members under torsion, combined torsion and bending moment for determination of energy absorption

--oOo—

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1			1	1	1	1	1	
CO2	2	1		1	2				1	1	1	2
CO3	2	1		1	2				1	1	1	2
CO4	2	1		1	2				1	1	1	2
CO5	2	1		1	2				1	1	1	2
CO6	2	1		1	2				1	1	1	2

CE 405C WATER QUALITY AND TREATMENT

Instruction Hours/Week : 3(L) **Credits : 3**
Sessional Marks : 40 **End Semester Examinations Marks : 60**

Course Educational Objective (CEOs)

1. To know the water quality of different sources and water demand estimation.

2. To analyze the distribution network
3. To learn about the water quality parameters
4. To know the design concepts of water treatment plant
5. To study the advanced water treatment methods.

UNIT – I

SOURCES AND DEMAND OF WATER: Different sources of water, quantity and quality of different sources, Types and variation in water demand, factors affecting water demand, design period, population forecasting – Different methods and their suitability.

UNIT-II

WATER COLLECTION, CONVEYANCE AND DISTRIBUTION: Intake works for collection of surface water – Conveyance of water – Gravity and pumping – Their design – Different materials used for conveying conduits and their suitability, systems of distribution – Distribution reservoirs – Distribution networks, design of simple and complex pipe networks, pipe accessories – Valves and their location and suitability.

UNIT – III

WATER USES AND QUALITY REQUIREMENTS: Sources of water pollution, water borne diseases. Need for protected water supply,water quality – Physical, chemical and biological characteristics, water quality standards for different uses.

WATER TREATMENT: Conventional water treatment processes units and their functions. Theory and design of aeration,coagulation, flocculation and clarification, Determination of optimum dose of alum for coagulation of water.

UNIT – IV

FILTRATION AND DISINFECTION: Theory of Filtration – Different types of filters and their design. Disinfection – Disinfectant's mechanism of disinfection – Different methods of Disinfection. Types of Chlorination - Break point chlorination.

UNIT – V

ADVANCED TREATMENT METHODS: Treatment methods for removal of fluorides, arsenic, hardness, iron and manganese, salinity, colour.

TEXT BOOKS :

1. Water Treatment Principles and Design by James M. Montgomery.
2. Water Supply Engineering, by S.K.Garg.

3. Environmental Engineering by H.S.Peavy et al.
4. Water Supply and Sewerage, by E.W.Steel.

Course Outcomes (COs)

After completion of the course the student will be:

- Able to estimate the water demand of any area and understand the water sources and its quality
- Able to solve the distribution network problems
- Able to explain the water quality parameters
- Able to plan and design water treatment plant
- Able to understand advanced water treatment technologies

--oOo—

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	1		1	1		1	1	1
CO2	2	2	2	2	1		1	1		1	1	1
CO3	2	2	2	2	1		1	1		1	1	1
CO4	2	2	2	2	1		1	1		1	1	1
CO5	2	2	2	2	1		1	1		1	1	1

CE 406C SOIL MECHANICS

Instruction Hours/Week : 2(L)+1(T) **Credits : 3**
Sessional Marks : 40 **End Semester Examinations Marks : 60**

Course Objectives:

The objectives of this course is:

1) To enable the student to find out the index properties of the soil and classify it.
2) To enable the students to differentiate between compaction and consolidation of soils and to determine the consolidation settlement.
3) To enable the student to determine permeability of soils using various methods.
4) To impart the concept of seepage of water through soils and determine the seepage discharge.
5) To enable the students to determine Shear Strength of soils using various methods.

UNIT- I

SOIL COMPOSITION AND PHASE RELATIONSHIPS:

Types of soils - formation and deposition - Phase composition and Soil as 3−Phase system- Weight-Volume parameters : moisture content, unit weights, degree of saturation, voids ratio, porosity, specific gravity, mass specific gravity - Relationship between various soil parameters - Determination of Moisture content, Specific gravity and Unit weights using various methods.

UNIT -II

IDENTIFICATION AND CLASSIFICATION OF SOILS:

Index properties- Determination of particle size-Dry Sieve Analysis &Sedimentation Analysis- Determination of Consistency limits-liquid limit, plastic limit, shrinkage limit - Indices from Index properties-Density Index, Plasticity, Liquidity and Consistency indices, Flow & Toughness indices - Soil classification based on particle size , texture - Unified and Indian standard soil classification systems – Engineering significance of classification and classification parameters- Tests for field identification of soils

UNIT -III

SOIL WATER & EFFECTIVE STRESS PRINCIPLE:

Mode, Occurrence and types of soil water – Geostatic stresses in soils - capillarity – Total Stress- Pore water pressure- Effective Stress Principle - nature of effective stress, effect of ground level, surcharge &water table on effective stress.

PERMEABILITY & SEEPAGE ANALYSIS:

Darcy's law- coefficient of permeability: determination by constant-head and falling-head methods-Permeability of stratified soils - factors affecting Permeability -Movement of water through soils- stream and potential functions - flow nets, graphical method to plot flow nets- seepage pressure - quick sand condition.

UNIT- IV

CONSOLIDATION OF SOILS:

comparison between compaction and consolidation, initial, primary & secondary consolidation - Terzaghi's theory of consolidation, final settlement of soil deposits, computation of consolidation settlement and secondary consolidation.

UNIT – V

SHEAR STRENGTH OF SOILS:

Shear strength of soils - Mohr'-Coulomb Failure Criteria - Measurement of shear strength - Direct shear, Unconfined compression and Tri-axial compression tests - Shear strength parameters - Shear strength of cohesive and cohesion less soils - Test conditions - Stress Paths under different stress conditions.

TEXT BOOKS:

1. C. Venkataramiah, Geotechnical Engineering, New age International Pvt. Ltd, (2002).
2. K. R. Arora, Soil Mechanics and Foundation Engg., Standard Publishers and Distributors, Delhi.

REFERENCES:

1. Gopal Ranjan & A. S. R. Rao, Basic and Applied Soil Mechanics, New age International Pvt . Ltd, New Delhi.
2. Braja M. Das Principles of Geotechnical Engineering, Cengage Learning

3. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Soil Mechanics and Foundation, Laxmi publications Pvt. Ltd., New Delhi

Course Outcomes:

At the end of the course, the student must be able to:

- Identify and classify various soils based on their characteristics.
- Compute effective stress under different conditions
- Evaluate permeability and seepage of soils.
- Understand consolidation in soils and Calculate consolidation time and settlement of soils.
- Understand shear strength theories and Determine Shear Characteristics of soils

--oOo—

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	1	1					1	1
CO2	2	2	2	2	1	2	1		1		1	1
CO3	2	2	2	2	2	2	1		1	1	1	1
CO4	2	2	2	1	1	2	1		1	1	1	1
CO5	2	2	2	2	2	2	1		1	1	1	1

CE407P FLUID MECHANICS AND HYDRAULIC MACHINES LAB

Instruction Hours/Week : 3(P) Credits : 1.5

Sessional Marks : 40 End Semester Examinations Marks : 60

Course Educational Objective (CEOs)

1. To determine the coefficient of discharge in flow measuring devices.
2. To determine the coefficients of different losses in pipe flow.
3. To draw the performance characteristic curves of pumps.

FLOW MEASUREMENT

1. Calibration of Small Orifice
2. Calibration of Venturimeter
3. Calibration of Orifice meter
4. Calibration of Bend meter
5. Calibration of Triangular Notch

HEAD LOSSES IN PIPES

6. Determination of Friction factor of the pipe material
7. Determination of Head Loss coefficient due to Sudden Contraction
8. Determination of Head loss coefficient due to Gate Valve in a pipe line
9. Determination of Head Loss coefficient due to Bend in a pipe line

HYDRAULIC MACHINES

10. Characteristic curves of 0.8 kW two stage centrifugal pump
11. Characteristic curves of variable speed centrifugal pump

Course Outcomes (COs)

After completion of the course the student will be:

- Able to calibrate the flow measuring devices.
- Able to calculate loss coefficients for use in the pipe flow analysis.
- Able to prepare the characteristic curves of the pumps.

--oOo—

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1		2				1	1	2
CO2	2	2	2	1		2				1	1	2
CO3	2	2	2	1		2				1	1	2

CE408P SOIL MECHANICS LABORATORY

Instruction Hours/week : 2 (P) **Credits :1**

Sessional Marks : 40 **Semester-end Examination: 60**

Course Educational Objective (CEOs)

The course should enable the students to:

1. Develop laboratory skills in dealing with soil as a medium of water flow , for structural support and a primary building material.
2. Know the procedure to measure /determine engineering properties of soils in the laboratory.
3. To conduct following experiments on different types of soils to arrive the engineering properties.

List of Experiments

1. Grain Size Distribution by Dry Sieve Analysis.
2. Grain Size Distribution by Hydrometer Analysis
2. Specific Gravity of soils and Free Swell Index
3. Consistency limits by Liquid limit and by Plastic limit
4. In-situ density using Core Cutter method and Shrinkage Limit of given soil pat
5. Shrinkage Limit of given soil
6. In-situ density by Sand Replacement method.
7. I.S. Light Compaction test/ Standard Proctor Compaction test

Course Outcomes (COs)

After completion of the course the student will be able to:

1. Depict the procedures for measuring the engineering properties of soils.
2. Describe the procedure for measuring the basic properties and compaction characterstics of soils.
3. Assess the soil for engineering applications

--oOo—

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2			1			1		1		
CO2	2	1	1							1		
CO3	2	1	1							1		

CE409S PYTHON PROGRAMMING

Instruction Hours/Week: 1(T) +2(P) **Credits : 2.0**
Sessional Marks : 40 **End Semester Examinations Marks : 60**

Course Educational Objective (CEOs)

1. Computer programming skills are now becoming part of basic education as these skills are increasingly of vital importance for future job and career prospects.

2. The Python programming language which is one of the most popular programming languages worldwide.
3. The course shows you how to use the free open-source Python to write basic programs and high-level applications using concepts such as Class, BIF of Python, functions, variables, If Else statements, For loops, While loops, iterative and recursive programs and algorithms such as the Insertion Sort algorithm.
4. This course will be of great interest to all learners who would like to gain a thorough knowledge and understanding of the basic components of computer programming using the Python language – and might be a gentle introduction to programming for those who think they might have a longer-term interest in the subject area.

UNIT I

Introduction to Python Programming Language: Introduction to Python Language: What is Python? Why Python? Installing Python on Windows, Python IDLE, Python Literals, Python Data Types Basic Input-Output operations, Operators in Python, Decision making in Python, Conditional execution in Python, Logical and bit operations in Python, Naming Conventions, String Operations, String Slices, String Operators, Numeric Data Types, Conversions, Data type conversion, Built in Functions.

UNIT II

Python Built-in Data Structures: Introduction, List, Tuples, Dictionary, Sets, List Operations append, extend, insert, remove, pop, slice, and reverse, List Comprehension, Dictionary operations, Sorting Dictionaries, Copying Collections, Set operations. Standard python modules math, time, IO and time, Regular expressions, multi-threading.

UNIT III

Classes in Python, Principles of Object Oriented programming, Creating Classes, Instance Methods, File Organization, Special Methods, Class Variables, Inheritance, Polymorphism, Type Identification, Custom Exception Classes.

UNIT IV

Functions, I/O, Exception Handling in Python

Introduction:Defining your own functions, keyword and optional parameters, mapping functions, lambda functions, **Data Streams:** Creating Your Own Data Streams · Access Modes · Writing Data to a File · Reading Data From a File · Additional File Methods · Using Pipes as Data Streams · Handling IO Exceptions · Working with Directories · Metadata · Errors · Run Time Errors · The Exception Model · Exception Hierarchy · Handling Multiple Exceptions

Unit V

Python API development.

Introduction to API, Python API programming, Python web application frameworks, REST API, Python Flask, Flask Environment, Routing, Cookies, Sessions, Running Flask Application, Testing API with POSTMAN client

Course Outcomes (COs)

Upon completion of this course, students should be able to

1. Apply the OOP principles and best practices of python programming.
2. Write clear and effective pythonic code.
3. Create applications using python programming.
4. Implementing databases using SQLite and Access databases using python programming.
5. Understand and feel comfortable in working with web application frameworks.
6. Develop APIs required for the web applications using web frameworks like Flask and Fast API.

Reference Book:

1. Dive into Python, Mike

2. Learning Python, 4th Edition by Mark Lutz

3. Programming Python, 4th Edition by Mark L

Fundamentals of Python Programming, Richard L. Halterman Updated content of the book is maintained under the URL:http://python.cs.southern.edu/pythonbook/pythonbook.pdf

The official Python Tutorial. http://docs.python.org/tut/ How to think like a computer scientist (interactive) http://interactivepython.org/runestone/static/thinkcspy/index.html

How to think like a computer scientist http://openbookproject.net/thinkcs/python/english3e/

Code Academy Python http://www.codecademy.com/tracks/python A useful hands-on book: http://anh.cs.luc.edu/python/hands-on/3.1/Hands-onPythonTutorial.pdf

1. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher, Revised and Expanded version (Referred by MIT)
2. Python Programming using problem solving Approach by Reema Thareja, Oxford University, Higher Education Oxford University Press; First edition (10 June 2017), ISBN-10: 0199480173

3. Data Structures and Algorithms in Python by Michael T Goodrich and Robertto Thamassia, Micheal S Goldwasser, Wiley Publisher (2016) Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material Course Technology Inc. 1 st edition (6th February 2009

--oOo—

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2					1		1	1
CO2	2	2	2	2					1		1	1
CO3	2	2	2	2					1		1	1
CO4	2	2	2	2					1		1	1
CO5	2	2	2	2					1		1	1
CO6	2	2	2	2					1		1	1

CE410P COMPUTER AIDED BUILDING DRAWING

Instruction Hours/Week : 3(P) **Credits : 1.5**
Sessional Marks : 40 **End Semester Examinations Marks : 60**

Course Educational Objective (CEOs)

1) Develop parametric design and the conventions of formal engineering drawing
2) Produce and interpret 2D drawings
3) Communicate a design idea/concept graphically/ visually
4) Examine a design critically and with understanding of AUTOCAD software.

UNIT- I

INTRODUCTION: Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer aided drawing, coordinate systems, reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards.

UNIT- II

SYMBOLS AND SIGN CONVENTIONS: Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards

UNIT- III

MASONRY BONDS: English Bond and Flemish Bond – Corner wall and Cross walls – One brick wall and one and half brick wall

UNIT- IV

BUILDING COMPONENTS: Terms, Doors, Windows, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan.

UNIT- V

TYPICAL BUILDING DRAWINGS: A Building, An Office building, A Dwelling, A Residential House, Plan of a Secondary School, Bank, Primary Health Centre, Duplex House.

It may be advisable to conduct Drawing sessions along with Lab demonstrations.

Text book:

Building Planning and Drawing – Dr. N. Kumaraswamy and A. Kameshwara Rao – CHARATOR PUBLISHING HOUSE**.**

COURSE OUTCOMES:

At the end of the course the student will be able to

- Develop drawing skills for effective demonstration of building details.
- Draw building plans using Computer Aided Design and Drafting soft wares.
- Develop engineering project drawings incorporating details and design parameters in 2D.
- Examine efficacy of AUTOCAD design and Drawing.

--oOo—

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		2		2	1	1	2	1	1	1	2
CO2	2		2		2	1	1	2	1	1	1	2
CO3	2		2		2	1	1	2	1	1	1	2
CO4	2		2		2	1	1	2	1	1	1	2

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

ACADEMIC YEAR 2021-22

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

M.TECH STRUCTURAL ENGINEERING

PROGRAM OUTCOMES (POS):

After completion of the program graduates will be able to

1. Apply the knowledge of science, mathematics, and engineering principles for developing problem solving attitude.

2. Identify, formulate and solve engineering problems in the domain of structural engineering field.

3. Use different software tools for Analysis and Design structural engineering domain. Design and conduct experiments, analyse and interpret data, for development of simulation experiments.

4. Function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1. To prepare programme graduates with foundation knowledge to perform analysis and design various structures and participate in quality control systems.
2. T o provide programme graduates with entrepreneur skills to take up individual projects or work in teams in the field of structural engineering and in multidisciplinary environments.
3. To inculcate in programme graduates an interest towards research work in the relevant domain or appropriate domains for providing sustainable solutions to the Civil Engineering Problems.

M. Tech (STRUCTRAL ENGINEERING) – I Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Program Core									
SEPC01	Advanced Structural Analysis	3	-	-	3	3	40	60	100
SEPC02	Advanced Solid Mechanics	3	-	-	3	3	40	60	100
Program Elective- I Any One from the Following		3	-	-	3	3	40	60	100
SEPE11	Theory of Thin Plates and Shells								
SEPE12	Theory and Applications of Cement Composites								
SEPE13	Theory of Structural Stability								
Program Elective- II Any One from the following		3	-	-	3	3	40	60	100
SEPE21	Analytical and Numerical Methods for Structural Engineering								
SEPE22	Structural Health Monitoring								
SEPE23	Structural Optimization								
Program Practicals									
SECP01	Structural Design Lab	-	-	4	4	2	40	60	100
SECP02	Advanced Solid Mechanics Lab	-	-	4	4	2	40	60	100
Audit Course-I		2	-	-	2	-	100	-	100
PGPA11	English for Research Paper Writing								
PGPA12	Disaster Management								
PGPA13	Sanskrit for Technical Knowledge								
PGPA14	Value Education								
Mandatory Course									
PGPC41	Research Methodology and IPR	2	-	-	2	2	40	60	100
	Total	16	-	8	24	18	380	420	800

ACADEMIC YEAR – 2018-19
M.Tech. Structural Engineering I Semester
(Subjects, Electives, Labs offered)

SEPC01 ADVANCED STRUCTURAL ANALYSIS

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Course Objectives: This Course Will Enable Students:

- To understand the static and kinematic indeterminacy of the structures
- To understand the concepts of matrix methods of analysis of structures
- To understand the analysis of continuous beams.
- To understand the analysis of rigid and pin jointed frames

UNIT-I

INFLUENCE COEFFICIENTS: Physical Significance, Effects of Settlements, Temperature Change and Lack of Fit, Member Approach and Structure Approach.

UNIT-II

STIFFNESS METHOD APPLIED TO LARGE FRAMES: Local Coordinates and Global Coordinates.

STIFFNESS MATRIX ASSEMBLY OF STRUCTURES: Stiffness Matrix in Global Co ordinates, Boundary Conditions, Solution of Stiffness Matrix Equations, Calculation of Reactions and Member Forces.

UNIT-III

APPLICATIONS TO SIMPLE PROBLEMS: Beams, Plane Trusses, Plane Rigid Jointed Frames and Grids by Structure Approach and Member Approach.

UNIT-IV

BOUNDARY VALUE PROBLEMS (BVP): Approximate Solution of Boundary Value Problems, Modified GalerkinMethod for One-Dimensional BVP, Matrix Formulation ofthe Modified GalerkinMethod.

UNIT-V

LINEAR ELEMENT: Shape Functions, Solution for Poisson's Equation, General OneDimensional Equilibrium Problem.

References:

1. Matrix Analysis of Framed Structures, Weaver and Gere.
2. The Finite Element Method, Lewis P. E. and WardJ. P., Addison-Wesley Publication Co.
3. Computer Methods in Structural Analysis, MeekJ. L., E and FN, Span Publication.
4. The Finite Element Method, Desai and Able, CBS Publication.

Course outcomes: At the end of the course, students will be able to

1. Analysis the structures due to the effects of settlements and temperature changes.
2. Analyze the skeleton structures using stiffness analysis code.
3. Use direct stiffness method understanding its limitations
4. Study the fundamentals of FEM

CO-PO MAPPING

CLO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	2	1	1		3	3	2
CO2	3	3	2	1		3	3	2
CO3	3	3	3	1		3	3	2
CO4	2	2	2	1		3	3	2

SEPC02 ADVANCED SOLID MECHANICS

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Course Objectives: This Course Will Enable Students:

- To make students understand the principles of elasticity.
- To familiarize students with basic equations of elasticity
- To expose students to two dimensional problems in Cartesian and polar coordinates.
- To make students understand the principle of torsion of prismatic bars.

UNIT-I

INTRODUCTION TO ELASTICITY: Displacement, Strain and Stress Fields, Constitutive Relations, Cartesian Tensors and Equations of Elasticity.

STRAIN AND STRESS FIELD: Elementary Concept of Strain, Stain at a Point, Principal Strains and Principal Axes, Compatibility Conditions, Stress at a Point, Stress Components on an Arbitrary Plane, Differential Equations of Equilibrium, Hydrostatic and Deviatoric Components.

UNIT-II

EQUATIONS OF ELASTICITY: Equations of Equilibrium, Stress- Strain relations, Strain Displacement and Compatibility Relations, Boundary Value Problems, Co-axiality of the Principal Directions.

UNIT-III

TWO-DIMENSIONAL PROBLEMS OF ELASTICITY: Plane Stress and Plane Strain Problems, Airy's stress Function, Two-Dimensional Problems in Polar Coordinates.

UNIT-IV

TORSION OF PRISMATIC BARS: Saint Venant's Method, Prandtl's Membrane Analogy, Torsion of Rectangular Bar, Torsion of Thin Tubes.

UNIT-V

PLASTIC DEFORMATION: Strain Hardening, Idealized Stress- Strain curve, Yield Criteria, von Mises Yield Criterion, Tresca Yield Criterion, Plastic Stress-Strain Relations, Principle of Normality and Plastic Potential, Isotropic Hardening.

References:

1. Theory of Elasticity, Timoshenko S. andGoodierJ. N., McGraw Hill, 1961.
2. Elasticity,SaddM.H.,Elsevier,2005.
3. Engineering Solid Mechanics, RagabA.R., BayoumiS.E., CRC Press,1999.
4. Computational Elasticity, AmeenM., Narosa,2005.
5. Solid Mechanics, KazimiS. M. A., Tata McGraw Hill,1994.
6. Advanced Mechanics of Solids, SrinathL.S., Tata McGraw Hill,2000.

Course outcomes: At the end of the course, students will be able to

1. Solve simple problems of elasticity and plasticity understanding the basic concepts.
2. Apply numerical methods to solve continuum problems.
3. Study the two-dimensional problems of Elasticity.
4. Solving the tensional problem of prismatic beam.
5. Solve the problems of plasticity understanding the basic concepts.

CO-PO MAPPING

CLO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	2	1	1		3	2	2
CO2	3	3	3	2		3	2	2
CO3	2	2	2	1		2	2	2
CO4	2	2	2	1		2	1	1
CO5	2	2	2	1		2	2	2

SEPE11 THEORY OF THIN PLATES AND SHELLS

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Course Objectives: This Course Will Enable Students:

- Introduce with concept of plate theory,the behaviour and analysis Knowledge about classification of shell surfaces
- To analyse the plate with different boundary conditions
- To understand the classical theory oh shells based on the kirchoff-love assumptions

Syllabus Contents:

UNIT-I

INTRODUCTION: Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using Principle of Virtual Work, Boundary Conditions

UNIT-II

STATIC ANALYSIS OF PLATES: Governing Equation for a Rectangular Plate, Navier Solution for Simply- Supported Rectangular Plate under Various Loadings, Levy solution for Rectangular Plate with other Boundary Conditions.

UNIT-III

CIRCULAR PLATES: Analysis under Axi- Symmetric Loading, Governing Differential Equation in Polar Co-ordinates. Approximate Methods of Analysis- Rayleigh-Ritz approach for Simple Cases in Rectangular Plates.

UNIT-IV

STATIC ANALYSIS OF SHELLS: MEMBRANE THEORY OF SHELLS - Cylindrical, Conical and Spherical Shells,

UNIT-V

SHELLS OF REVOLUTION: WITH BENDING R**ESISTANCE** - Cylindrical and Conical Shells, Application to Pipes and Pressure Vessels.

References:

1. Theory of Plates and Shells, Timoshenko S. and KriegerW., McGraw Hill.

2. Stresses in Plates and Shells, UguralAnsel C., McGraw Hill.

3. Thin Elastic Shells, KrausH., John Wiley and Sons.

4. Theory of Plates, Chandra shekhar K., Universities Press.

5. Design and Construction of Concrete Shells, Ramaswamy G.S.

Course Outcomes: At the end of the course, students will be able to

1. Use analytical methods for the solution of thin plates and shells.

2. Use analytical methods for the solution of shells.

3. Apply the numerical techniques and tools for the complex problems in thin plates.

4. Apply the numerical techniques and tools for the complex problems in shells.

CO-PO MAPPING

CLO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3	3	2	1		2	2	3
CO2	3	3	3	1		2	2	3
CO3	3	2	2	1		2	2	3
CO4	3	2	2	1		2	2	3

SECP01 ADVANCED STRUCTURAL ANALYSIS LAB

P / week : 4Hrs
University Exam : 3 Hrs

Sessional Marks : 40
End Exam Marks : 60

Course Objectives: This Course Will Enable Students:

- To design of reinforced concrete beam
- To design of reinforced concrete slab
- To analyze and design of multi storey building
- To design special multi storey frame structures

Syllabus Content:
Design and detailed drawing of complete G+ 3 structures by individual student using latest relevant IS codes.

Course Outcomes: At the end of the course, students will be able to

1. Design and Detail all the Structural Components of Frame Buildings.
2. Design and Detail complete Multi-Storey Frame Buildings.

CO-PO MAPPING

CLO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	3	2	1		3	3	2
CO2	2	3	3	1		3	3	2

SEPE22 STRUCTURAL HEALTH MONITORING

L / L / week	: 3Hrs	Sessional Marks	: 40
University Exam	: 3 Hrs	End Exam Marks	: 60

Syllabus Contents:

UNIT-I

STRUCTURAL HEALTH: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance.

UNIT-II

STRUCTURAL HEALTH MONITORING: Concepts, Various Measures, Structural Safety in Alteration.

STRUCTURAL AUDIT: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.

UNIT-III

STATIC FIELD TESTING: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.

UNIT-IV

DYNAMIC FIELD TESTING: Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.

UNIT-V

INTRODUCTION TO REPAIRS AND REHABILITATIONS OF STRUCTURES: Case Studies (Site Visits), piezo– electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.

Reference Books:

1. Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006.
2. Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.
3. Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006.
4. Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc, 2007.

Course Outcomes: At the end of the course, students will be able to

1. Diagnosis the distress in the structure understanding the causes and factors.
2. Assess the health of structure using static field methods.
3. Assess the health of structure using dynamic field tests.
4. Suggest repairs and rehabilitation measures of the structure.

CO-PO MAPPING

CLO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	2	2	1		3	3	2
CO2	2	2	2	1		2	3	2
CO3	2	2	2	1		2	3	2
CO4	2	2	2	1		2	3	2

SECP02 ADVANCED SOLID MECHANICS LAB

P / week : 4Hrs Sessional Marks : 40

University Exam : 3 Hrs End Exam Marks : 60

Course Objectives :

- To investigate the performance of structural elements.
- To evaluate the different testing methods and equipments.

List of Experiments/Assignments:

Study of stress-strain curve of high strength concrete, Correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.

Effect of cyclic loading on steel.

Non-Destructive testing of existing concrete members.

Behaviour of Beams under flexure, Shear and Torsion.

Reference Books:

1. Properties of Concrete, Neville A. M., 5th Edition, Prentice Hall, 2012. Concrete Technology, Shetty M. S., S. Chand and Co., 2006.

Course Outcomes: At the end of the course, students will be able to

1. Design high grade concrete and study the parameters affecting its performance.
2. Conduct Non Destructive Tests on existing concrete structures.
3. Apply engineering principles to understand behavior of structural/ elements.

CO-PO MAPPING

CLO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	2	1	1		3	3	2
CO2	2	2	3	1		3	3	2
CO3	2	2	3	1		3	3	3

PGPA12 DISASTER MANAGEMENT (Audit Course - I)

Instruction Hours/week : 2(L) **Credits : -**

Sessional Marks : 100 **Semester-end Examination : -**

Course Objectives: This course will enable students:

- Learn to demonstrate critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from Multiple perspectives.
- Developanunderstandingofstandardsofhumanitarianresponseandpracticalrelevanceinspecific types of disasters and conflict situations
- Critically under standthestrengthsandweaknessesofdisastermanagementapproaches,planning and programming in different countries, particularly their home country or the countries they work in

UNIT I

Introduction

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; natural and Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT II

Repercussions Of Disasters And Hazards

Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Manmade disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III

Disaster Preparedness And Management Preparedness

Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT IV

Risk Assessment Disaster Risk

Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.Course

UNIT V

Disaster Mitigation Meaning

Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

References:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.

2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.

3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

Course outcomes: At the end of the course, students will be able to:

1. demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

2. critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

3. develop the standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

4. critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

CO-PO MAPPING

CLO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	1							
CO2			2					

CO3							**1**	
CO4			**2**					
CO5			**1**					
CO6							**2**	

PGMC 41 RESEARCH METHODOLOGY AND IPR

Instruction Hours/week : 2(L) **Credits : 2**

Sessional Marks : 40 **Semester-end Examination : 60**

Course Objectives:

- Identify an appropriate research problem in their interesting domain.
- Understand ethical issues understand the Preparation of a research project thesis report.
- Understand the Preparation of a research project thesis report
- Understand the law of patent and copyrights.
- Understand the Adequate knowledge on IPR

UNIT I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT II

Effective literature studies approaches, analysis, Plagiarism, Research ethics

UNIT III

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT IV

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT. Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT V

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2nd Edition , “Research Methodology: A Step by Step Guide for beginners”
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
5. Mayall , “Industrial Design”, McGraw Hill, 1992.
6. Niebel , “Product Design”, McGraw Hill, 1974.
7. Asimov , “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New
9. Technological Age”, 2016.
10. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Outcomes: At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understand that when IPR would take such important place in growth of individuals & Nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

CO-PO MAPPING

CLO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	1							
CO2			2					
CO3							1	

CO4			**2**					
CO5			**1**					
CO6							**2**	

M. Tech (STRUCTRAL ENGINEERING) – II Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Program Core									
SEPC03	FEM in Structural Engineering	3	-	-	3	3	40	60	100
SEPC04	Structural Dynamics	3	-	-	3	3	40	60	100
Program Elective- III Any One from the following		3	-	-	3	3	40	60	100
SEPE31	Advanced Steel Design								
SEPE32	Design of Formwork								
SEPE33	Design of High Rise Structures								
SEPE34	Design of Masonry Structures								
Program Elective- IV Any One from the following		3	-	-	3	3	40	60	100
SEPE41	Design of Advanced Concrete Structures								
SEPE42	Advanced Design of Foundations								
SEPE43	Soil Structure Interaction								
SEPE44	Design of Industrial Structure								
SEPE45	--								
Program Practicals									
SECP03	Core Lab III Model Testing Lab	-	-	4	4	2	40	60	100
SECP04	Core Lab IV Numerical Analysis Lab	-	-	4	4	2	40	60	100
Audit Course-II		2	-	-	2	-	100	-	100
PGPA21	Constitution Of India								
PGPA22	Pedagogy Studies								
PGPA23	Stress Management By Yoga								
PGPA24	Personality Development Through Life Enlightenment Skills								
Mini Project									
SEMP01	Mini Project with Seminar	-	-	4	4	2	100	-	100
	Total	14	-	12	26	18	440	360	800

ACADEMIC YEAR – 2018-19
M.Tech. Structural Engineering II Semester
(Subjects, Electives, Labs offered)

SEPC03 FINITE ELEMENT METHOD IN STRUCTURAL ENGINEERING

L / week : 3Hrs Sessional Marks : 40

University Exam : 3 Hrs End Exam Marks : 60

Syllabus Contents:

Course Objectives: This Course Will Enable Students:

- To provide an overview and basic fundamentals of Finite Element Analysis.
- To introduce basic aspects of finite element theory, including domain discretization, interpolation, application of boundary conditions, assembly of global arrays, and solution of the resulting algebraic systems.
- To explain the underlying concepts behind variational methods and weighted residual methods in FEM.
- Formulate simple structural problems in to finite elements

UNIT-I

INTRODUCTION: History and Applications. Spring and Bar Elements, Minimum Potential Energy Principle, Direct Stiffness Method, Nodal Equilibrium equations.

UNIT-II

BEAM ELEMENTS: Assembly of Global Stiffness Matrix, Element Strain and Stress. Flexure Element, Element Stiffness Matrix, Element Load Vector.

UNIT-III

METHOD OF WEIGHTED RESIDUALS: Galerkin Finite Element Method, Application to Structural Elements, Interpolation Functions, Compatibility and Completeness Requirements, Polynomial Forms, Applications.

UNIT-IV

Types: Triangular Elements, Rectangular Elements, Three-Dimensional Elements, Isoparametric Formulation, Axi-Symmetric Elements, Numerical Integration, Gaussian Quadrature.

UNIT-V

APPLICATION TO SOLID MECHANICS: Plane Stress, CST Element, Plane Strain Rectangular Element, Isoparametric Formulation of the Plane Quadrilateral Element, Axi-Symmetric Stress Analysis, Strain and Stress Computations.

COMPUTER IMPLEMENTATION of FEM procedure, Pre-Processing, Solution, Post-Processing, Use of Commercial FEA Software (Practice Only).

Reference Books:

1. Finite Element Analysis, Seshu P., Prentice-Hall of India,2005.
2. Concepts and Applications of Finite Element Analysis, Cook R. D., Wiley J., New York, 1995. Fundamentals of Finite Element Analysis, Hutton David, Mc-Graw Hill, 2004.
3. Finite Element Analysis, Buchanan G.R., McGraw Hill Publications, New York, 1995. Finite Element Method, Zienkiewicz O.C. & Taylor R.L. Vol. I, II & III, Elsevier, 2000.
4. Finite Element Methods in Engineering, Belegundu A.D., Chandrupatla, T.R., Prentice Hall India, 1991.

Course Outcomes: At the end of the course, students will be able to

1. Use Finite Element Method for structural analysis.
2. Execute the Finite Element Program/ Software.
3. Solve continuum problems using finite element analysis.
4. Develop the FEM software.

CO-PO MAPPING

CLO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3	3	3	1		3	2	3
CO2	2	3	3	1		3	3	3
CO3	3	3	3	1		3	3	3
CO4	1	1	3	1		3	3	3

SEPC04 STRUCTURAL DYNAMICS

L/week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks: 60

Course Objectives: This Course Will Enable Students to

- Determine vibration characteristics of structures like frequency, amplitude, impedence and time
- period Differentiate the response of single and multi degree of freedom systems
- Determine the response of structures for pulse excitation like blast load
- Differentiate the response of Multi Degree of Freedom systems

UNIT - I

RESPONSE OF SIMPLE – SINGLE DEGREE OF FREEDOM SYSTEM

Definition of DOF – Idealization of structure as SDOF system – Formulation of equations of motion for various SDOF systems – Free vibration of un-damped systems – Determination of natural frequency - Free vibration of viscously damped systems – Determination of Damping in structures.

UNIT - II

RESPONSE OF SINGLE DEGREE OF FREEDOM SYSTEMS- FORCED VIBRATIONS

Forced vibration of systems – Steady state response to harmonic forces – Duhamel's integral-Numerical Evaluation – Response to support motion – Transmissibility – Construction of response Spectrum.

UNIT - III

ANALYSIS OF MULTI-DEGREE OF FREEDOM SYSTEMS

Formal Derivations — Formulation of equation of motion - Evaluation of natural frequencies and modes — Free vibration of undamped systems — Forced vibration of damped systems.

UNIT — IV

APPROXIMATE METHODS OF COMPUTING NATURAL FREQUENCIES

Rayleigh's method – Dunkerley's method – Methods of iteration – Stodola – Vainello Method – Rayleigh – Ritz method.

UNIT — V

DYNAMIC ANALYSIS OF CONTNUOUS SYSTEM

Vibration of flexural beams — Equation of motion — Free vibrations of Uniform Beams - Natural frequencies and Mode Shapes of Beams with different Support Conditions - Orthogonality Condition between Normal Modes.

Reference Books:

1. Dynamics of Structures, Clough R. W. and Penzien J., Mc Graw Hill.
2. Structural Dynamics and Introduction to Earthquake Engineering, Chopra A. K.
3. Vibration of Structures - Application in Civil Engineering Design, Smith J. W., Chapman and Hall.
4. Dynamics of Structures, Humar J. L., Prentice Hall.
5. Structural Dynamics - Theory and Computation, Paz Mario, CBS Publication.
   Dynamics of Structures, Hart and Wong.

Course Outcomes: At the end of the course, students will be able to

1. Analyze and study dynamics response of single degree freedom system using fundamental theory and equation of motion.
2. Analyze and study dynamics response of Multi degree freedom system with lumped parameter using fundamental theory and equation of motion.
3. Analyze and study dynamics response of Multi degree freedom system with distributed man and load.
4. Study the concepts of dynamic effects due to wind loading, moving loading & vibrations caused by Traffic, Blasting & Pile driving.
5. Use the available software for dynamic analysis.

CO-PO MAPPING

CLO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3	3	2	1		3	2	2

CO2	**3**	**3**	**2**	**1**		**3**	**2**	**2**
CO3	**3**	**2**	**3**	**1**		**3**	**2**	**2**
CO4	**2**	**3**	**2**	**1**		**2**	**2**	**2**
CO5	**2**	**2**	**3**	**1**		**2**	**2**	**2**

SEPE33 DESIGN OF HIGH RISE STRUCTURES

L / week : 3Hrs Sessional Marks : 40
University Exam : 3 Hrs End Exam Marks : 60

UNIT-I
DESIGN OF TRANSMISSION/ TV TOWER, MAST AND TRESTLES: Configuration, bracing system, analysis and design for vertical transverse and longitudinal loads.

UNIT-II
ANALYSIS AND DESIGN OF RC AND STEEL CHIMNEY, Foundation design for varied soil strata.

UNIT-III
TALL BUILDINGS: Structural Concept, Configurations, various systems, Wind and Seismic loads,

UNIT-IV
Dynamic approach, structural design considerations and IS code provisions. Firefighting design provisions.

UNIT-V
APPLICATION of software in analysis and design.

Reference Books:
1. Structural Design of Multi-storeyed Buildings, Varyani U. H., 2nd Ed., SouthAsian Publishers, New Delhi, 2002.

2. Structural Analysis and Design of Tall Buildings, Taranath B. S., Mc Graw Hill, 1988.
3. Illustrated Design of Reinforced ConcreteBuildings(GF+3storeyed), Shah V. L. &Karve S. R., Structures Publications, Pune, 2013.
4. Design of Multi Storeyed Buildings, Vol. 1 & 2, CPWD Publications, 1976. Tall Building Structures, Smith Byran S. and Coull Alex, Wiley India. 1991. High Rise Building Structures, Wolfgang Schueller, Wiley., 1971.
5. Tall Chimneys, Manohar S. N., Tata Mc Graw Hill Publishing Company, New Delhi

Course Outcomes: At the end of the course, students will be able to

1. Analyse, design and detail Transmission/ TV tower, Mast and Trestles with different loading conditions.
2. Analyse, design and detail the RC and Steel Chimney.
3. Analyse. design and detail the tall buildings subjected to different loading conditions using relevant codes.

4. Analysis and design of dynamic approach OF STRUCTURAL DESIGN USING is Code provisions.

CO-PO MAPPING

CLO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	2	2	1		2	3	2
CO2	2	3	3	1		2	3	2
CO3	2	3	2	1		2	3	2
CO4	2	3	3	1		2	3	3

SEPE41 DESIGN OF ADVANCED CONCRETE STRUCTURES

L / week : 3Hrs Sessional Marks : 40
University Exam : 3 Hrs End Exam Marks : 60

Course Objectives: This Course Will Enable Students:

- To design of reinforced concrete beam
- To design of reinforced concrete slab
- To analyze and design of multi storey building and Industrial Building
- To design special structures such as Deep beams,Corbels and Grid Floors

Syllabus Contents

UNIT – I

ESTIMATION OF CRACK WIDTH AND REDISTRIBUTION OF MOMENTS IN REINFORCED CONCRETE BEAMS :

Factors affecting crack width in beams - Calculation of crack width - Empirical Method - Estimation of crack width in beams by IS 456 - Shrinkage and thermal cracking - Redistribution of moments in a fixed beam and a two-span continuous beam - Advantage and disadvantages of moment redistribution.

UNIT – II

DESIGN OF RIBBED (VOIDED) SLABS & GRID FLOORS :

Analysis of the ribbed slabs for moment and shears - Design for shear - Deflections - Arrangement of reinforcements.

Analysis of grid floors by Timoshenko's plate theory, stiffness matrix method - Equating joint deflections - Detailing of steel.

UNIT – III

DESIGN OF PLAIN CONCRETE WALLS :

Braced and unbraced walls - Eccentricities of vertical loads - Empirical design method (walls carrying axial load) - Design of wall for In-plane horizontal forces.

DESIGN OF SHEAR WALLS :

Steps of designing deep beams by IS 456 - Detailing of deep beams.

UNIT – IV

EARTH QUAKE FORCES AND STRUCTURAL RESPONSE :

Earthquake magnitude and intensity - Determination of design forces - Torsion in buildings - Ductile detailing of beams - Columns and frame members with axial force and moment.

DESIGN OF SHEAR WALLS :

Classification of shear walls - Loads in shear walls - Design of rectangular and flanged shear walls - Moment of resistance of rectangular shear walls

REFERENCES :

1) P.C.Varghese, "Advanced Reinforced Concrete Design", Prentice-Hall of India, Private Ltd., New Delhi.

2) P.C.Varghese, "Limit State Design of Reinforce Concrete", Prentice-Hall of India, Private Ltd., New Delhi.

3) Krishna Raju, "Advanced Reinforced Concrete Design - SI Units" CBS, New Delhi, 1986.

4) Blume, J.A., Newmark, N.M. and Corning, L.M. "Design of Multi-Storey Reinforced Concrete Buildings for Earth Quake Motion", Portland Cement Association, Chicogo, 1961.

5) Pankaj Agarwal, "Earthquake Resistant Structures", Prentice-Hall of India, Private Ltd., New Delhi.

Course Outcomes: At the end of the course, students will be able to

1. Model the loads and findings the material properties.
2. Design deep beams and corbels
3. Design of shear walls using IS, ACI & Errocode.
4. Analyse the special structures by understanding their behaviour in torsional buckling.
5. Design and prepare detail structural drawings for execution citing relevant IS codes.

CO-PO MAPPING

CLO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	3	2	1		2	3	2
CO2	2	3	2	1		2	3	2
CO3	2	3	3	1		2	3	2
CO4	2	3	2	1		2	3	2
CO5	2	3	2	1		2	2	2

SECP03 MODEL TESTING LAB

L/week : 4Hrs Sessional Marks : 40
University Exam : 3 Hrs End Exam Marks: 60

Course Objectives: The students will acquire knowledge about

- To investigate the performance of structural elements.
- To evaluate the different testing methods and equipments

Concrete:

Properties and testing of fresh and hardened concrete

Concrete Mix Design

Non-Destructive Testing of Concrete

Reinforced Concrete:

Under- reinforced and over-reinforced beams

Column

Steel:

Testing of steel beams under static loading including measurement of strains (Using electric resistance strain gauges)

Course Outcomes: At the end of the course, student will be able to

1. Plan the test set-up for model testing
2. Understand the behavior of structural components.

CO-PO MAPPING

CLO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2							
CO2							2	

SECP04 NUMERICAL ANALYSIS LAB

P / week	: 4Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Course Objectives: The students will acquire knowledge

- To develop MATLAB codes for solution of simultaneous linear equations
- To construct codes for 1D Finite Element problems.
- To code for numerical integration techniques & statistical methods.

Syllabus Contents:

Find the Roots of Non-Linear Equation Using Bisection Method. Find the Roots of Non-Linear Equation Using Newton's Method. Curve Fitting by Least Square Approximations. Solve the System of Linear Equations Using Gauss - Elimination Method.

Solve the System of Linear Equations Using Gauss - Seidal Iteration Method. Solve the System of Linear Equations Using Gauss - Jorden Method.

Integrate numerically using Trapezoidal Rule. Integrate numerically using Simpson's Rules.

Numerical Solution of Ordinary Differential Equations By Euler's Method.

Numerical Solution of Ordinary Differential Equations ByRunge- Kutta Method.

Course Outcomes: At the end of the course, students will be able to

1 Find Roots of non-linear equations by Bisection method and Newton's method.
2 Do curve fitting by least square approximations by using matlab
3 Solve the system of Linear Equations using Gauss - Elimination/ Gauss - Seidal Iteration/ Gauss - Jorden Method
4 To Integrate Numerically Using Trapezoidal and Simpson's Rules
5 To Find Numerical Solution of Ordinary Differential Equations by Euler's Method, Runge- Kutta Method

CO-PO MAPPING

CLO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	1							
CO2			2					
CO3							1	
CO4			2					
CO5			1					

M. Tech (STRUCTRAL ENGINEERING) – III Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Program Elective- IV Any One from the following		3	-	-	3	3	40	60	100
SEPE51	Design of Pre-stressed Concrete Structures								
SEPE52	Analysis of Laminated Composite Plates								
SEPE53	Fracture Mechanics of Concrete Structures								
SEPE54	Design of Plates and Shells								
SEPE55	--								
Open Elective Any One from the Following		3	-	-	3	3	40	60	100
SEOE11	Business Analytics								
SEOE12	Industrial Safety								
SEOE13	Operations Research								
SEOE14	Cost Management of Engineering Projects								
SEOE15	Composite Materials								
SEOE16	Energy Generation from Waste								
Dissertation									
SEPD01	Dissertation- Phase-I	-	-	20	20	10	100		100
	Total	6	-	20	26	16	180	120	300

ACADEMIC YEAR – 2018-19
M.Tech. Structural Engineering III Semester
(Subjects, Electives, Labs offered)

SEPE51 DESIGN OF PRESTRESSED CONCRETE STRUCTURES

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Course Objectives: This Course Will Enable Students:

- Familiarize students with concrept of prestressing and analysis of prestress
- Design and analysis of pretension and post tensioned concrete members
- Determination of deflections of prestressed members
- To calculate the losses of prestress,creep and shrinkage.

Syllabus Contents

UNIT-I

INTRODUCTION TO PRESTRESSED CONCRETE: types of prestressing, systems and devices, materials, losses in prestress. Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads, ultimate strength in flexure, code provision.

UNIT-II

STATICALLY DETERMINATE PSC BEAMS: design for ultimate and serviceability limit states for flexure, analysis and design for shear and torsion, code provisions.

TRANSMISSION OF PRESTRESS in pretensioned members; Anchorage zone stresses for post tensioned members.

UNIT-III

STATICALLY INDETERMINATE STRUCTURES - Analysis and design - continuous beams and frames, choice of cable profile, linear transformation and concordancy.

UNIT-IV

COMPOSITE CONSTRUCTION with precast PSC beams and cast in-situ RC slab - Analysis and design, creep and shrinkage effects. Partial prestressing - principles, analysis and design concepts, crack-width calculations. Analysis and design of pre stressed concrete pipes

References:

1. Design of Prestressed Concrete Structures, Lin T.Y., Asia Publishing House, 1955.
2. Prestressed Concrete, Krishnaraju N., Tata McGraw Hill, New Delhi, 1981.
3. Limited State Design of Prestressed Concrete, GuyanY., Applied Science Publishers, 1972.
4. IS: 1343- Code of Practice for Prestressed Concrete
5. IRC: 112

Course outcomes: At the end of the course, students will be able to

1. Find out losses in the pre-stressed concrete. Understand the basic aspects of pre-stressed concrete fundamentals, including pre and post-tensioning processes.
2. Analyse pre-stressed concrete deck slab and beam/ girders.
3. Design pre-stressed concrete deck slab and beam/ girders.
4. Design of end blocks for pre-stressed members.

CO-PO MAPPING

CLO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2							
CO2			1					
CO3								2
CO4			2					

SEOE 12 INDUSTRIAL SAFETY

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination: 60**

Course Objectives:

- To know about Industrial safety programs and toxicology, Industrial laws , regulations and source models
- To understand about fire and explosion, preventive methods, relief and its sizing methods
- To analyze industrial hazards and its risk assessment.

UNIT I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in achine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment’s like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

References:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Course outcomes:

At the end of the course, students will be able to

1. To list out important legislations related to health, Safety and Environment.
2. To list out requirements mentioned in factories act for the prevention of accidents.
3. To understand the health and welfare provisions given in factories act.

CO-PO MAPPING

CLO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	1							
CO2			2					
CO3							2	
CO4			1					

M. Tech (STRUCTRAL ENGINEERING) – IV Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Dissertation									
SEPD02	Dissertation- Phase-II	-	-	32	32	16	40	60	100
Total		-	-	32	32	16	40	60	100