DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING:

TIRUPATI-517502

R-20 – Scheme of Instructions effective from the academic year 2020 – 2021

Programme Scheme

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING

(AUTONOMOUS)

SRI VENKATESWARA UNIVERSITY

TIRUPATI-517502 (A.P), INDIA.

Vision of the Department:

To be a lead department imparting quality and value embedded higher education and research emphasizing freedom of learning and practice.

Mission of the Department:

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

1. PO1- **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems related to Electronics & Communication and Engineering.
2. PO2- **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems related to Electronics & Communication Engineering and reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. PO3- **Design/development of solutions:** Design solutions for complex engineering problems related to Electronics & Communication Engineering and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. PO4- **Conduct investigations of complex problems:** 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. PO5- **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. PO6- **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the Electronics & Communication Engineering professional engineering practice.
7. PO7- **Environment and sustainability:** Understand the impact of the Electronics & Communication Engineering professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. PO8- **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. PO9- **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. PO10- **Communication:** Communicate effectively on complex engineering activities with the engineering community and with 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. PO11- **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to manage projects and in multidisciplinary environments.
12. PO12- **Life-long learning:** 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.

Program specific outcomes (PSOs)

1. PSO1- Competence in analysis and design of analog and digital system using hardware and software tools.
2. PSO2- Understand, analyse the present and future generations of wireless communication technologies.

Programme Educational Objectives (PEOs)

ECE graduates will

1. PEO 1- have adequate analytical capabilities and practical knowledge to attend to the current challenging tasks and to absorb futuristic trends.
2. PEO 2- have adequate analytical capabilities and practical knowledge to attend to the current challenging tasks and to absorb futuristic trends.
3. PEO 3- able to abreast with the latest hardware and software design techniques and cutting-edge technologies.
4. PEO 4- able to enhance the knowledge and skills continually throughout their career and to make them capable to adapt in diverse environments.
5. PEO 5- imbibe leadership qualities among the students to take up challenging roles in their career by ensuring professional ethics with high sense of social responsibility.

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
R-20 – Scheme of Instruction effective from the academic year 2020-2021
B. Tech (Electronics and Communications Engineering)

SEMESTER-I (First Year)

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits
		Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
MA 101	Mathematics-I	3	1	-	4	4
PY 102	Modern Physics	3	1	-	4	4
CS 103	Programming for Problem Solving	2	1	-	3	3
EC 104	Electronic Devices	3	1	-	4	4
ME 105	Workshop/ Manufacturing Practices	-	-	3	3	1.5
CS 106	Programming for Problem Solving Lab	-	-	3	3	1.5
CE 107	Environmental Sciences	4	-	-	4	0
					Total	**18**

Category	CREDITS
Basic Science Course	11
Professional Core Course -PCC	07
Skill Oriented Course-SC	00
TOTAL CREDITS	**18**

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
R-20 – Scheme of Instruction effective from the academic year 2020-2021
B. Tech (Electronics and Communications Engineering)

SEMESTER-II (First Year)

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits
		Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
MA 201	Mathematics-II	3	1	-		4
CY 202	Engineering Chemistry	3	1	-		4
EN 203	English	2	-	-		2
EE 205	Basic Electrical Engineering	3	1	-		4
ME 205	Engineering Graphics and Design	2	-	3		3.5
EN 206	English Communication Lab	-	-	3		1.5
					Total	**19**

Category	**CREDITS**
Basic Science Course	11.5
Professional Core Course -PCC	7.5
Skill Oriented Course-SC	00
TOTAL CREDITS	**19**

- All courses - 40 marks (Internal) + 60 marks (Univ. Semester End)
- Audit Course – 100 marks (Internal) - Zero Credits

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
R-20 – Scheme of Instruction effective from the academic year 2020-2021
B. Tech (Electronics and Communications Engineering)

Semester III (Second Year)

S. No.	Course Code	Category	Course Title	Hours/Week			Credits	Scheme of Evaluation Marks		Total Marks
				L	T	P		Internal	End Sem	
1	MA301B	BSC	Mathematics-III	3	0	0	3	40	60	100
2	EC302C	PCC	Network Theory	3	0	0	3	40	60	100
3	EC303C	PCC	Signals and Systems	3	0	0	3	40	60	100
4	EC304C	PCC	Electromagnetic Waves and Transmission Lines	3	0	0	3	40	60	100
5	EC305C	PCC	Digital Logic Design	3	0	0	3	40	60	100
6	EC306C	PCC	Analog Circuits	3	0	0	3	40	60	100
7	EC307L	PCC-Lab	Basic Electrical Engineering lab	0	0	3	1.5	40	60	100
8	EC308L	PCC-Lab	Electronic Devices lab	0	0	3	1.5	40	60	100
9	EC309S	SC	Entrepreneurship and Design Thinking	2	0	0	2	100	--	100
10	MC310A	MC	Constitution of India	2	0	0	0	100	--	100
11	EC311L	PCC-Lab	Simulation Lab	0	0	2	1	100	---	100
Total Credits				**22**	**0**	**8**	**24**	**620**	**480**	**1100**

Category	**CREDITS**
Basic Science Course	03
Professional Core Course -PCC	19
Skill Oriented Course-SC	02
TOTAL CREDITS	**24**

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
R-20 – Scheme of Instruction effective from the academic year 2020-2021
B. Tech (Electronics and Communication Engineering)
Semester IV (Second Year)

S. No.	Course Code	Category	Course Title	Hours/Week			Credits	Scheme of Evaluation Marks		Total Marks
				L	T	P		Internal	End Sem	
1	EC401C	ESC	Linear Control Systems	3	0	0	3	40	60	100
2	EC402C	PCC	Probability theory and Stochastic Process	3	0	0	3	40	60	100
3	HS403C	HSS	Managerial Economics and Accountancy	3	0	0	3	40	60	100
4	EC404C	PCC	IC Applications	3	0	0	3	40	60	100
5	EC405C	PCC	Analog Communications	3	0	0	3	40	60	100
6	EC406L	PCC-Lab	Digital Logic Design lab	0	0	3	1.5	40	60	100
7	EC407L	PCC-Lab	Analog Circuits Lab	0	0	3	1.5	40	60	100
8	EC408L	PCC-Lab	IC Applications Lab	0	0	3	1.5	40	60	100
9	EC409S	SC	Python Programming	1	0	2	2	100	---	100
10		MC	NSS/ NCC/ NSO Activities	0	0	0	-	-	-	-
			Total Credits	**16**	**0**	**11**	**21.5**	**420**	**480**	**900**

Category	CREDITS
Professional Core Course -PCC	13.5
Engineering Science course—ESC	03
Humanities and Social sciences-HSS	03
Skill Oriented Course-SC	02
TOTAL CREDITS	**21.5**

All undergraduate students shall register for NCC/NSS/NSO activities in First semester of B.Tech. A student will be required to participate in an activity for two hours in a week during second and third semesters i.e., 60 hours. Grade shall be awarded as Satisfactory or Unsatisfactory in the mark sheet on the basis of participation, attendance, performance and behaviour. If a student gets an unsatisfactory Grade, he/she shall repeat the above activity in the subsequent years, in order to complete the degree requirements**.**

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
SCHEME OF INSTRUCTION –CHOICE BASED CREDIT SYSTEM
B. Tech (Electronics and Communication Engineering)
R-20 – Program Effective for the batch admitted from the Academic Year 2020-21

Semester V (Third Year)

S. No.	Course Code	Category	Course Title	Hours/Week			Credits	Scheme of Evaluation Marks		Total Marks
				L	T	P		Internal	End Sem	
1	EC501C	PCC	Computer Organization & Architecture	3	0	0	3	40	60	100
2	EC502C	PCC	Microprocessors and Microcontrollers	3	0	0	3	40	60	100
3	EC503C	PCC	Digital Signal Processing	3	0	0	3	40	60	100
4	EC504C	PCC	Antennas and Wave Propagation	3	0	0	3	40	60	100
5	EC505C	PCC	Digital Communications	3	0	0	3	40	60	100
6	EC506L	PCC-Lab	Microprocessors and Microcontrollers Lab	0	0	3	1.5	40	60	100
7	EC507L	PCC-Lab	Digital Signal Processing Lab	0	0	2	1	40	60	100
8	EC508L	PCC-Lab	Analog and Digital Communications Lab	0	0	3	1.5	40	60	100
9	EC509S	SOC	Web Design and Development	1	0	2	2	100	---	100
10	EC510A	MC	Universal Human Values	2	0	0	0	100	----	100
Community Service Project (CSP) during second year (To be evaluated during V semester) with duration greater than 45 hours.				0	0	0	1.5	100	-----	100
Total Credits							**22.5**	**620**	**480**	**1100**

L – Lecturer hours; Tut. – Tutorials; P/D – Practical or Drawing; T – Total

Category	**CREDITS**
Professional Core Course -PCC	19
Skill Oriented Course-SOC-Internal evaluation for 100 Marks	2
Summer Internship	1.5
TOTAL CREDITS	**22.5**

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
SCHEME OF INSTRUCTION –CHOICE BASED CREDIT SYSTEM
B.Tech (Electronics and Communication Engineering)
R-20 – Program Effective for the batch admitted from the Academic Year 2020-21

Semester VI (Third Year)

S.NO	Course Code	Category	Course Title	Hours/Week			Credits	Scheme of Evaluation Marks		Total Marks
				L	T	P		Internal	End Sem	
1	EC601C	PCC	Microwave Engineering	3	0	0	3	40	60	100
2	EC602C	PCC	Computer Networks	3	0	0	3	40	60	100
3	EC603C	PEC	Professional Elective-I	3	0	0	3	40	60	100
4	EC604C	PEC	Professional Elective-II	3	0	0	3	40	60	100
5	EC605C	OEC	Open Elective-1(Through MOOCS)	3	0	0	3	100	0	100
6	EC606C	OEC	Open Elective-2(Through MOOCS)	3	0	0	3	100	0	100
7	EC607L	PCC-Lab	Microwave Engineering Lab	0	0	3	1.5	40	60	100
8	EC608L	PCC-Lab	Computer Networks Lab	0	0	3	1.5	40	60	100
9	EC609S	SOC	Internet of Things and Applications	2	0	0	2	100	--	100
10	EC610MC	MC	Professional Ethics in Engineering.	2	0	0	0	100	--	100
Summer Internship with duration of 4 to 6 weeks (To be evaluated during VII semester)				0	0	0				
Total Credits							**23**	**640**	**360**	**1000**

L – Lecturer hours; Tut. – Tutorials; P/D – Practical or Drawing; T - Total

Category	CREDITS
Professional Core Course -PCC	9
Professional Elective- PEC	6
Open Elective Course/Job Oriented elective-OEC	6
Skill Oriented Course-SOC -Internal evaluation for 100 Marks	2
TOTAL CREDITS	**23**

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
SCHEME OF INSTRUCTION –CHOICE BASED CREDIT SYSTEM
B.Tech (Electronics and Communication Engineering)
R-20 – Program Effective for the batch admitted from the Academic Year 2020-21
Semester VII (Fourth Year)

S.NO	Code	Category	Course Title	Hours/Week			Credits	Scheme of Evaluation Marks		Total Marks
				L	T	P		Internal	End Sem	
1	EC701C	PCC	Digital Image and Video Processing	3	0	0	3	40	60	100
2	EC702C	PEC	Professional Elective-III	3	0	0	3	40	60	100
3	EC703C	PEC	Professional Elective-IV	3	0	0	3	40	60	100
4	EC704C	PEC	Professional Elective-V	3	0	0	3	40	60	100
5	EC705C	OEC	Open Elective-III (Through MOOCS)	3	0	0	3	100	0	100
6	EC706C	OEC	Open Elective-IV (Through MOOCS)	3	0	0	3	100	0	100
7	EC707S	SOC	Machine Learning	2	0	0	2	100	0	100
8	EC708I		Summer Internship (4 to 6 Weeks) completed during VI Semester				3	100	0	100
TOTAL CREDITS							**23**	**560**	**240**	**800**

L – Lecturer hours; Tut. – Tutorials; P/D – Practical or Drawing; T - Total

Category	CREDITS
Professional Core Course -PCC	3
Professional Elective- PEC	9
Open Elective Course/Job Oriented elective-OEC	6
Skill Oriented Course-SOC-Internal evaluation for 100 Marks	2
Industrial/Research Internship	3
TOTAL CREDITS	**23**

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
SCHEME OF INSTRUCTION –CHOICE BASED CREDIT SYSTEM
B. Tech (Electronics and Communication Engineering)
R-20 – Program Effective for the batch admitted from the Academic Year 2020-21
Semester VIII (Fourth Year)

S.NO	Course Code	Category	Course Title	Hours/Week			Credits	Scheme of Evaluation Marks		Total Marks
				L	T	P		Internal	End Sem	
1		**Major Project**	Project-Work and Internship	0	0	24	12	40	60	100
						Total Credits	**12**			**100**

L – Lecturer hours; Tut. – Tutorials; P/D – Practical or Drawing; T – Total

S. No.	Semester	Credits
1.	I	18
2.	II	19
3.	III	23
4.	IV	22.5
5.	V	22.5
6.	VI	23
7.	VII	23
8.	VIII	12
	TOTAL CREDITS	**163**

B.Tech. (R20) Program Electives				
I	**II**	**III**	**IV**	**V**
(VI-Semester)	**(VI-Semester)**	**(VII-Semester)**	**(VII-Semester)**	**(VII-Semester)**
CMOS VLSI Design	Cyber Security	Neural Networks and Fuzzy Logic	Satellite Communication	Embedded System Design
Information Theory and Coding	Nano Electronics	Radar Engineering	Fiber Optic Communication	Real Time Operating Systems
Optimization Techniques	Sensors and Transducers	Testing and Testability	Wireless Communication	FPGA Based System Design
Hardware-Software Co-design	Electronic Instrumentation	Bio-Medical Instrumentation	MEMS	Digital Signal Processors & Architectures

Courses offered for Honors degree

S.No.	Course Code	Course Title	Prerequisite if any	Contact Hours per week		Credits
				L	T	
Any 4(Four)From the Following 6(Six) Courses						
1	ECHN01	Advanced Digital Signal Processing	Digital Signal Processing	3	1	4
2	ECHN02	Antennas and Radiating Systems	Antenna and Wave Propagation	3	1	4
3	ECHN03	Wireless and Mobile Communications	Digital Communications	3	1	4
4	ECHN04	Voice and Data Networks	NIL	3	1	4
5	ECHN05	Advanced Communication Networks	Computer Networks	3	1	4
6	ECHN06	Pattern recognition and Machine Learning	Digital Image & Video Processing	3	1	4
Two courses to be pursued through MOOCS with duration of 8 weeks each.						
7	ECHN07	Remote Sensing				2
8	ECHN08	Optical Networks				2
9	ECHNO9	Cloud Computing				2
	Total Credits					**20**

Courses offered for Minors in Electronics

S. No	Course Code	Course Title	Prerequisite if any	Contact Hours per week			Credits
				L	T	P	
Any 4(Four)From the Following 6(Six) Courses							
1.	ECMN01 (EC 104)	Electronic Devices	NIL	3	1	0	4
2.	ECMN02 (EC305C)	Digital Logic Design	NIL	3	1	0	4
3.	ECMN03 (EC306C)	Analog Circuits	Electronic Devices	3	1	0	4
4	ECMN04(EC404C)	IC Applications	Analog Circuits	3	1	0	4
5	ECMN05 (EC604C-Program Elective-II)	Electronic Instrumentation	Electronic Devices	3	1	0	4
6	ECMN06 (EC603C --Program Elective-I)	CMOS VLSI Design	1.Electronic Devices 2.Analog Circuits	3	1	0	4
Two courses to be pursued through MOOCS with a duration of 8 weeks							
7	ECMN07	Internet of Things and Applications					2
8	ECMN08	Sensors and Transducers					2
9	ECMN09	Micro-electromechanical Systems (MEMS)					2
10	ECMN10	Microprocessors and Micro Controllers					2
	Total Credits						20

Courses offered for Minors in Communications

S.No	Course Code	Course Title Offered in Semester	Prerequisite if any	Contact Hours per week			Credits
				L	T	P	
Any 4(Four)From the Following 7(Seven) Courses							
1.	ECMN11 (EC303C)	Signals & Systems	1.Mathematics-I 2.Mathematics-II	3	1	0	4
2.	ECMN12 (EC402C)	Probability theory & Stochastic Process	1.Mathematics-I 2.Mathematics-II	3	1	0	4
3.	ECMN13 (EC405C)	Analog Communications	NIL	3	1	0	4
4.	ECMN14 (EC505C)	Digital Communications	1. Signals & Systems 2. Probability theory & Stochastic Process	3	1	0	4
5.	ECMN15 (EC504C)	Antenna Wave Propagation	Electromagnetic Waves and Transmission Lines	3	1	0	4
6.	ECMN16 (EC601C)	Microwave Engineering	Antenna Wave Propagation	3	1	0	4
7.	ECMN17 (EC602C)	Computer Networks	NIL	3	1	0	4
8.	ECMN18 (EC604C-Program Elective-II)	Cyber Security	NIL	3	1	0	4

Two courses to be pursued through MOOCS with duration of 8 weeks							
9.	ECMN19	Satellite Communications					2
10.	ECMN20	Fiber optic Communications					2
11.	ECMN21	Mobile Communications					2
	Total Credits						20

FIRST YEAR SYLLABUS

I Semester MA 101MATHEMATICS –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 and also apply differential equations to engineering problems.
2. Use transformation to convert one type into another type presumably easier to solve, and also use shift theorems to compute the Laplace transform, inverse Laplace transform and the solutions of second order, linear equations with constant coefficients.

3. Solve an initial value problem for an nth order ordinary differential equation using the Laplace transform, and also expand functions as power series using Maclaurin's and Talor's series
4. Optimize the problems related to or, computer science, probability and statistics and also 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.
5. Use multiple integral in evaluating area and volume of any region bounded by the given curves.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	1	-	1	2	1	2	2	3	-	-	-
CO2	1	3	3	1	-	1	1	1	2	1	3	-	-	-
CO3	2	3	3	1	-	1	2	1	2	2	3	-	-	-
CO4	1	2	2	1	-	1	2	1	1	1	3	-	-	-
CO5	1	2	1	2	-	2	1	1	1	1	3	-	-	-

I & II Semesters CY 101/ CY 202 ENGINEERING CHEMISTRY
(I Semester - CY 101 for Civil & Mechanical Engineering)
(II Semester -CY 202 for EEE, ECE & CSE)
Instruction: 3(L) +1(T) /week Credits: 4 Assessment: 40 + 60

UNIT I

Atomic and molecular structure (**12 lectures**)
Postulates of quantum chemistry. Schrodinger equation. Particle in a box solution, 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 phenomenon.

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:

1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistry by P. W. Atkins
6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Ed.
7. 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, and also list major chemical reactions that are used in the synthesis of molecules.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	1	-	-	-	-	-
CO2	1	1	3	-	-	-	-	-	1	-	-	-	-	-
CO3	1	2	2	2	-	-	-	2	1	-	-	-	-	-
CO4	1	1	2	2	2	-	1	2	1	1	-	-	-	-

I Semester CH 102 CHEMISTRY FOR CHEMICAL ENGINEERING – I
(I Semester –For Chemical Engineering)
Instruction: 3(L) +1(T) /week Credits: 4 Assessment: 40 + 60

UNIT I

Introduction to quantum theory for chemical systems:
Schrodinger equation, Applications to Hydrogen atom, Atomic orbitals, many electron atoms

UNIT II

Chemical bonding in molecules:
MO theory, Structure, bonding and energy levels of bonding and shapes of many atom molecules, Coordination Chemistry, Electronic spectra and magnetic properties of complexes with relevance to bio-inorganic chemistry, organ metallic chemistry

UNIT III

Introduction to Stereochemistry:
Stereo descriptors – R, S, E, Z. Enantiomers and Diastereomers. Racemates and their resolution. Conformations of cyclic and acyclic systems.

UNIT IV

Reactivity of organic molecules:
Factors influencing acidity, basicity, and nucleophilicity of molecules, kinetic vs. thermodynamic control of reactions

UNIT V

Strategies for synthesis of organic compounds:
Reactive intermediates substitution, elimination, rearrangement, kinetic and thermodynamic aspects, role of solvents.

Text / Reference Books:

1. Physical Chemistry: G.W.Castellan, Narosa
2. Organic Chemistry: Finar; I.L. — Vol — I & II, Pearson Education
3. Organic Chemistry: Morrison & Boyd; PHI/Pearson Education.
4. Physical Chemistry: P. W. Atkins: Oxford.
5. A Text book of Physical Chemistry: K. L. Kapoor: Macmillan
6. A guide Book to Mechanism in Organic Chemistry: Peter Sykes
7. Organic Chemistry: Loudon: Oxford

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

1. Appreciate quantum theory of chemical systems
2. Appreciate aliphatic chemistry and stereochemistry
3. Write simple mechanisms.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	1	-	-	-	-	-
CO2	1	1	3	-	-	-	-	-	1	-	-	-	-	-
CO3	1	2	2	2	-	-	-	2	1	-	-	-	-	-

I & II Semester EN 203 ENGLISH
(I Semester - EN 103 for ChE, CE & ME)
(II Semester - EN 203 for EEE, ECE & CSE)
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 Resource Book. 2001
4. Study Writing. LizHamp- Lyonsand Ben Heasly. Cambridge University Press. 2006.
5. Communication Skills. Sanjay Kumarand Pushpalata. 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, literary texts such as Short stories and prose passages of English Language.
2. Maintain linguistic competence through training in vocabulary, sentence structures and pronunciation.
3. Develop communication skills by cultivating the habit of reading comprehension passages, language skills like listening, speaking, reading and writing.

4. Make use of self-instructed learner friendly modes of language learning through competence.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	2	-	3	2	2	3	-	-
CO2	-	-	-	-	3	-	-	-	2	-	-	1	-	-
CO3	-	-	-	-	-	-	-	-	3	-	3	2	-	-
CO4	-	-	-	-	-	-	-	-	3	-	2	3	-	-

I Semester EE104 BASIC ELECTRICAL AND ELECTRONICS ENGG
(I Semester – for ChE, CE & ME)
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.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	1	1	1	1	2	2	1	-	-
CO2	3	3	-	-	-	1	1	-	-	1		1	-	-
CO3	3	3	3	3	2	1	1	1	1	1	2	-	-	-
CO4	2	3	2	1	3	1	-	-	2	2	3	2	3	2

I & II Semesters
ME 105 / ME 205ENGINEERING GRAPHICS AND DESIGN
(I Semester - ME105 for ChE, CE & ME)
(II Semester - ME205 for EEE, ECE & CSE)
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 & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.
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 orthographic projections of lines, planes, solids and sections of solids.

.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	1	-	-	-	-	-	-	-	1	-	-
CO2	3	1	2	1	-	-	-	-	-	-	-	-	-	-
CO3	3	1	2	1	-	-	-	-	-	-	-	-	-	-
CO4	3	1	2	1	-	-	-	-	-	-	-	1	-	-

I & II Semesters EN 106 / EN 206 ENGLISH COMMUNICATION LAB
(I Semester - EN 106 for ChE, CE & ME)
(II Semester - EN206 for EEE, ECE & CSE)

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.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	1	3	2	3	-	-

I Semester PY 102 MODERN PHYSICS
(For I Semester –EEE, ECE & CSE)
Instruction: 3(L) +1(T) /week Credits: 4 Assessment: 40 + 60

UNIT I
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 II
Band Theory of Solids : Classical Free Electron Theory of Metals – Success and Failures – Quantum Free Electron Theory – Fermi Factor – Electron in Periodic Potential – Bloch Theorem – Kronig – Penney Model – Distinction between Metals , Insulators and semiconductors- Energy Band Structures.

UNIT III
Semiconductors – Introduction- Intrinsic and Extrinsic Semiconductors – Density of states – Carrier Concentrations at Equilibrium – Hall Effect. PN Junction Diode – Energy Band Diagram – Forward and Reverse Bias- Current – Voltage characteristics – Applications- Zener Diode – Light Emitting Diode- Photo diode -Solar Cell – Semiconductor Laser.

UNIT IV
Electromagnetism and magnetic properties of Materials:
Laws of Electro statistics- Electric Current- Laws of Magnetism- Ampere`s, Faraday`s laws- Maxwell 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 hysteresis, Applications of ferromagnetic materials.

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 C60 (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.P. Basava Raju `` A Detailed Text Book of Engineering Physics” Sole Distributors, Subhash Stores Book Corner, Bangalore
3. Hitendra K. Malik and A.K. Singh ``Engineering Physics” Tata MC Graw 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. John Allison, ``Electronic Engineering Materials and Devices" Tata Mc Graw Hill Publications.
6. B. L Theraja, "Modern physics", S. Chand & Company.
7. V. Raghavan "Material Science", Tata McGraw Hill Publications.
8. M.S. Ramachandra Rao 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 and also understand the quantum mechanics and ultimately the quantum behavior of charged particles when they are in motion.
2. Identify and apply appropriate analytical and mathematical tools of Physics in solving Engineering problems and also apply knowledge of band theory in the area of electronics and understanding the basic electron transportation phenomenon in microdevices.
3. Understand the principles in electrostatics and electromagnetics and magnetic properties of materials, size depended properties of nano-dimensional materials and their effective utilization in making nano- and micro-devices for further microminiaturization of electronic devices.
4. Think and participate deeply, creatively, and analytically in emerging areas of engineering technology, analyze the basics of instrumentation, design of laboratory techniques, measurement, data acquisition, interpretation, and analysis and also provide multidisciplinary experiences throughout the curriculum.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	1	1	1	1	2	2	1	-	-
CO2	3	3	-	-	-	1	1	-	-	1	-	1	-	-
CO3	3	3	3	3	2	1	1	1	1	1	2	-	-	-
CO4	2	1	1	1	-	-	-	-	-	-	-	1	-	-

I & II Semesters CS 103 / CS203 PROGRAMMING FOR PROBLEM SOLVING
(I Semester –CS 103 for EEE, ECE & CSE)
(II Semester –CS 203 for ChE, CE & ME)
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, and decompose a problem into functions and synthesize a complete program.
3. Use arrays, pointers, strings and structures to formulate algorithms and programs and also use file to perform read and write operations.
4. 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, Reema Thareja, 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.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	1	-	3	-	2	2	-	-	-	-
CO2	2	1	3	-	2	-	-	-	-	-	-	-	-	-
CO3	2	3	1	3	3	-	2	-	-	-	-	-	-	-
CO4	2	3	2	1	1	-	2	-	-	-	-	-	-	-

I & II Semesters CE 104 / CE 204 ENGINEERING MECHANICS
(I Semester –CE 104 for EEE)
(II Semester –CE 204 for CE & ME)
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, and also understand the behavior of different internal forces under different types of loading.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2														
CO3														
CO4														

I Semester EC 104 ELECTRONIC DEVICES
(I Semester - for ECE only)
Instruction: 3(L) +1(T) /week Credits: 4 Assessment: 40 + 60

UNIT I

Semiconductor Materials: Atomic structure, Electrons in periodic Lattices, Classifying Materials: Semiconductors, conductors and insulators, Semiconductor material groups, Covalent bonding, Energy Bandgaps, Energy bands in intrinsic and extrinsic silicon /Germanium, Density of Impurity States, Electrical Conductivity and Mobility, , Electronic Properties of N-type and P-type semiconductors, Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors. Generation and recombination of carriers; Poisson and continuity equation, P-N junction characteristics, I-V Characteristics, and small signal switching models, Diode resistances and diode capacitances.

UNIT II

Diode models, Avalanche breakdown, Zener diode, Schottky diode, Tunnel diode, Varactor diode and their applications, Testing a diode.
Rectifiers: Diode equivalent circuits, Analysis of diode circuits, Characteristics and comparison of Half-wave, Full-wave and Bridge rectifiers, Analysis of filters (C, L, LC, and CLC) used with Full-wave rectifiers, line regulation and load regulation.

UNIT III

Bipolar Junction Transistors: Bipolar Junction Transistor action, PNP and NPN transistors, CB, CE, and CC configurations and their I-V characteristics, Analytical expressions for transistor characteristics, Typical junction voltages and maximum ratings. Determination of h-parameters from BJT characteristics, Ebers-Moll Model, Multi Emitter transistor.

UNIT IV

Bipolar Junction Transistor Biasing: Operating point, stabilization, thermal runaway.
Field Effect Transistors: Characteristics and parameters of JFET, Pinch off and saturation regions, MOS capacitor, Depletion and Enhancement type of MOSFET, I-V characteristics, and small signal models of MOS transistor, UJT and its I-V characteristics, Metal Semiconductor FET, FET biasing schemes.

UNIT V

Optoelectronic Devices: Principle of operation and characteristics of LED. LCD, LDR, Photoconductor, Photodiode, Phototransistor, Solar cell, PIN photodiode, Charge-Coupled Devices, APD (avalanche photodiode) and their applications.
Power Semiconductor Devices: Device structure, equivalent circuit and characteristics of PNPN Diode, SCR, DIAC and TRIAC.

Text /Reference Books:

1. Ben G. Steetman and Sanjay Kumar Banerjee, “Solid State Electronic Devices,” 7th edition, Pearson Publishers, 2015.
2. Jacob Millman, Christos Halkias, Chetan D Parikh, “**Integrated Electronics**: Analog and Digital Circuits and Systems”, 2nd Edition, Tata Mcgraw Hill Education Private Limited, 2011.

3. Allen Mottershead, “Electronic Devices and Circuits: An Introduction”, PHI Learning, 2011.
4. D. Neamen , D. Biswas "Semiconductor Physics and Devices", McGraw-Hill Education.
5. S. M. Sze and K. N. Kwok, “Physics of Semiconductor Devices,” 3rd edition, John Wiley & Sons, 2006.
6. C.T. Sah, “Fundamentals of solid-state electronics,” World Scientific Publishing Co. Inc, 1991.
7. Y. Tsividis and M. Colin, “Operation and Modeling of the MOS Transistor,” Oxford University Press, 2011.

Course Outcomes: At the end of the course, student will be able to

1. Understand the principles of semiconductor physics of the intrinsic, *p* and *n* type materials and also the characteristics of the diode and some special function diodes and their application in electronic circuits.
2. Use mathematics to analyze electronic devices typical of those in switching and rectifier circuits.
3. Understand and utilize the mathematical models of semiconductor junctions and transistors for circuits and systems.
4. Understand the characteristics of the transistors and opto-electronic devices and their application in electronic circuits and also apply thyristors in power switching and control circuits

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	1	-	-	1	-	-	1	1	-	-	-

I Semester MA 104 PROBABILITY AND STATISTICS
(I Semester - for CSE only)
Instruction: 3(L) +1(T) /week Credits: 4 Assessment: 40 + 60

UNIT I
Probability: Introduction, Axiomatic approach, Conditional probability, Baye's theorem, Stochastic process, Random variables, Discrete and Continuous distributions, Expectation, Variance, moments, Moments generating functions.

UNIT II
Distributions - Binomial, Poisson, Normal, Uniform, Exponential and Gamma. Properties and applications.

UNIT III
Estimator-Estimation of parameters by Method of moments and maximum likelihood-Testing of hypothesis-small sample tests-t-test, F-test and Chi-Square test.

UNIT IV
Correlation: Curve fitting by method of least squares-Linear, Quadratic and Exponential Fitting-Correlation-rank correlation-Regression analysis-Multiple correlation.

UNIT V
Quality Control: Concept of quality of a manufactured product-Causes of variation-Principle of Shewart Control charts-X-Chart, R-Chart, p-Chart, np-chart and C-Chart.

Text Books:

1. S P Gupta, Statistical Methods, 38th Edition, Sultan Chand & Sons Educational Publishers,2009.
2. Y K V Iyengar, et al, Probability and Statistics 2nd Edition S. Chand & Company Ltd,2010.
3. S C Gupta and V K Kapur, Fundamentals of Applied Statistics, 3rd Edition, Sultan Chand& Sons Educational Publishers.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	-	-	3	-	-	-	-	-	-	-	-
CO2	-	2	-	1	-	2	-	-	-	-	-	-	-	-
CO3	-	2	2	1	-	2	-	-	-	-	-	-	-	-
CO4	-	2	2	1	-	2	-	-	-	-	-	-	-	-

I & II Semesters ME 105 / 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. Fitting shop
3. Carpentry
4. Electrical wiring
5. Welding shop
6. Casting
7. Smithy
8. Plastic moulding & Glass Cutting

Examinations could involve the actual fabrication of simple components, utilizing one or
More of the techniques covered above.

Detailed Contents:
1. Manufacturing Methods-casting, forming, machining, joining, advanced manufacturing
2. methods
3. CNC machining, Additive manufacturing
4. Fitting operations & power tools.
5. Electrical &Electronics
6. Carpentry
7. Plastic moulding. Glass cutting
8. Metal casting.
9. Welding (arc welding & gas welding), brazing

The above course content is learnt by online videos/ppt presentations.

Text/Reference Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy 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 Manufacturing Engineering and Technology", 4thedition, PearsonEducationIndiaEdition,2002.
3. GowriP.Hariharanand A. SureshBabu, Manufacturing Technology–I" Pearson Education,2008.
4. Roy A. Lindberg, Processes and Materials of Manufacture",4thedition, Prentice Hall India,1998.
5. RaoP.N., "ManufacturingTechnology",Vol. I & II,TataMcGrawHillHouse, 2017.

Laboratory Outcomes

1. Upon completion of this laboratory course, students will be able to fabricate components with their own hands.
2. They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
3. By assembling different components, they will be able to produce small devices of their interest.
4. 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 fabricate components using different materials.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1	2	1	1	2	2	1	-	-	-	-
CO2	2	1	2	1	2	1	1	2	2	1	-	-	-	-
CO3	2	1	2	1	2	1	1	2	2	1	-	-	-	-
CO4	2	1	2	1	2	1	1	2	2	1	-	-	-	-

I & II Sem CS 106/ CS206 PROGRAMMING FOR PROBLEM SOLVING LAB
(CS 106 for EEE, ECE & CSE)
(CS 206 for ChE, CE & ME)
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, stdio.h, stdlib.h, string.h, conio.h and pre-processor directives.
7. Programs using pointers (int pointer, char pointer) 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 trance the execution of program written in C language.

Refence Books:

1. Scheldt H, C: The complete Reference, 4th Edition, Tata McGraw-Hill, 2022.
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.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	1	-	3	-	2	2	-	-	-	-
CO2	2	1	3	-	2	-	-	-	-	-	-	-	-	-

II Semester MA 201 MATHEMATICS 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 Jn(X)-Lengender polynomials-recurrence formulae-generating function for Pn(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, and also use Cayley Hamilton theorem to find inverses or powers of matrices.
2. Use eigen values and vectors to reduce quadratic forms to normal form, and also 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.
3. Use green's theorem to evaluate line integrals along simple closed contours on the plane and also use stokes' theorem to give a physical interpretation of the curl of a vector field
4. Use the divergence theorem to give a physical interpretation of the divergence of a vector field, and also 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.
5. Evaluate certain improper integrals to make them simple with introduction of gamma and beta functions, and also study certain special functions that arise in solving certain ordinary differential equations to model many physical phenomena.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	3	1	-	2	1	1	2	1	3	-	-
CO2	3	1	3	2	1	-	2	2	1	2	2	3	-	-
CO3	3	1	3	2	2	-	2	2	1	2	2	3	-	-
CO4	2	1	2	1	1	-	1	1	1	1	1	3	-	-
CO5	3	1	3	2	2	-	1	2	2	1	2	3	-	-

II Semester PY 202ENGINEERING PHYSICS
(II Semester - for ChE, CE& ME)
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 Electro statistics- 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

Nano Physics 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 C60 (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 Sanjeev Gupta `Unified Physics` Vol. I Jai Prakash Nath& Co., Meerut.

3. Hitendra K. Malik and A.K. Singh ``Engineering Physics” Tata MC Graw 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 course and also understand the quantum mechanics and ultimately the quantum behavior of charged particles when they are in motion.
2. Identify and apply appropriate analytical and mathematical tools of physics in solving engineering problems, and also apply the basic principles of mechanics of rigid body and continuous media and their applications unrest and the principles in electrostatics and electromagnetics and magnetic properties of materials.
3. Understand size depended properties of nano-dimensional materials and their effective utilization in making nano- and micro-devices for further microminiaturization of electronic devices, and also think and participate deeply, creatively, and analytically in emerging areas of engineering technology.
4. Learn the basics of instrumentation, design of laboratory techniques, measurement, data acquisition, interpretation, and analysis, and also provide multidisciplinary experiences throughout the curriculum.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	1	1	1	1	2	2	1	-	-
CO2	3	3	-	-	-	1	1	-	-	1	-	1	-	-
CO3	3	3	3	3	2	1	1	1	1	1	2	-	-	-
CO4	2	1	1	1	-	-	-	-	-	-	-	1	-	-

II Semester CY203CHEMISTRY FOR CHEMICAL ENGINEERING-II
(II Semester - For ChE only)
Instruction: 3(L) +1(T) /week Credits: 4 Assessment: 40 + 60

UNIT I
Colloids: Classification of colloids; Size and shape; preparation of sols; Origin of charge in Colloidal particles: Stability of Colloids: Kinetic. Optical & electrical Properties: Electro kinetic phenomena: Electrical Double Layer; Ultracentrifuge and Molecular weight determination of Macromolecules. Viscosity: Definition of viscosity of a liquid; Determination of Viscosity; Surface Tension: Introduction: Origin of Surface Tension: Surface energy, Capillarity; Contact Angle; Measurement of Surface Tension by Capillary rise method; Variation of Surface Tension of a liquid with Temperature and Concentration.

UNIT II
Kinetic theory of gases: Van der Waals Equation of state, Maxwell distribution law, vapour-liquid equilibrium, Colligative property. Adsorption: Introduction; Gibb's adsorption equation; Surface Excess; Adsorption isotherms: Freundlich, Langmuir, BET adsorption equations: Surface Films: Langmuir Balance: two-dimensional equation of state.

UNIT III
Introduction to quantum mechanics: Spectral shape pf Blackbody radiation, Planck's equation and a concept of quanta, breakdown of the classical equipartition principle, basic postulates of quantum mechanics, Hamiltonian function &Hamiltonian operator, important properties of a Hamiltonian operator, Heisenberg's uncertainty principle.

UNIT IV
Common organic reactions and their mechanisms: Friedel-Crafts, Claisen Condensation, Cannizaro, Aldolcondensation. Fischer-Troapsch synthesis, Birch reduction, pekins reaction, Riemer Tiemer reaction Wolf Kishner Reductio and Grignard reaction;

UNIT V
Aminoacids: Classification; General methods of preparation and properties of amino acids, polypeptide synthesis, General properties of proteins, colour tests, enzymes. Lipids, fats and steroids; nucleic acid, DNA & RNA - generation and structure. Carbohydrate: Classification, Glucose and fructose, Disaccharides: Sucrose, maltose.

Text / Reference Books:

1. Physical Chemistry: G.W.Castellan, Narosa
2. Organic Chemistry: Finar; I.L. — Vol — I & II, Pearson Education
3. Organic Chemistry: Morrison & Boyd; PHI/Pearson Education.
4. Physical Chemistry: P. W. Atkins: Oxford.
5. A Text book of Physical Chemistry: K. L. Kapoor: Macmillan
6. A guide Book to Mechanism in Organic Chemistry: Peter Sykes
7. Organic Chemistry: Loudon: Oxford

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

1. Understand the theoretical principles underlying molecular structure, bonding and properties
2. Know the fundamental concepts of structure and function in organic reactions, the use of Kinetics and thermodynamics to elucidate mechanisms of reactions
3. Predict reactivity patterns and propose reasonable mechanisms

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	1	-	-	-	-	-
CO2	1	1	3	-	-	-	-	-	1	-	-	-	-	-
CO3	1	2	2	2	-	-	-	2	1	-	-	-	-	-

II Semester EE 204 ELECTRICAL CIRCUITS
(II Semester - For ECE only)
Instruction: 3(L) +1(T) /week Credits: 4 Assessment: 40 + 60

UNIT-I

Basic Circuit Concepts: Electrical circuit elements (R, L and C), Classification of Circuit elements, Voltage and Current sources, Source transformation Techniques– Kirchhoff's laws – Star-delta transformation – Network reduction techniques - Mesh and Nodal Analysis for D.C. Circuits– Concept of mutual inductance – Dot convention.

UNIT-II

Network Topology: Graph, tree, incidence matrix, and tie set and cut set matrices – Formulation of equilibrium equations based on graph theory. Duality and dual circuits

A.C. Fundamentals: Periodic waveforms – Average and effective values of different waveforms - Form factor and crest factor.

UNIT-III

A.C. Circuits: Phase and phase difference – Phasor notation – Concept of reactance, impedance, susceptance and admittance – Power factor -Active and reactive power – Impedance Triangle-Power triangle – Steady State analysis of single-phase A.C. circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel) – Phasor diagrams. Mesh and Nodal Analysis for A.C. Circuits.

UNIT-IV

Resonance: Series and Parallel Resonance – Resonant frequency, Half power frequencies, bandwidth and Quality Factor.

Locus diagrams: Current locus diagrams of RL and RC series circuits and two branch parallel circuits.

UNIT-V

Three Phase Circuits: Advantages of three phase systems – Phase sequence – Balanced and Unbalanced systems – Magnitude and phasor relationships between line and phase voltages and currents in balanced star and delta circuits – Analysis of balanced and unbalanced three phase circuits with star and delta connected loads, Measurement of three phase power – Two wattmeter method

Text Books:

1. Sudhakar and Shyammohan, Circuits and Networks: Analysis and Synthesis, 5th Edition, Tata McGraw-Hill
2. Ravish R. Singh, Network Analysis and Synthesis, Tata Mc. Graw Hill.
3. Abhijit Chakrabarti: Circuit Theory Analysis and Synthesis, 7th Revised Edition, Dhanpat Rai & Co.

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

CO1: Explain the operation & Characteristic of DC machines.
CO2: Explain the operation & performance of transformer.
CO3: Calculate efficiency of various Induction motors.
CO4: Determine regulation by synchronous impedance method (OC test & SC test).

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	2	3	-	-	-	-	-	-	3	-	-	-

II Semester EE 205 BASIC ELECTRICAL ENGINEERING
(II Semester - for EEE only)
Instruction: 3(L) +1(T) /week Credits: 4 Assessment: 40 + 60

UNIT-I
Basic Circuit Concepts: Electrical circuit elements (R, L and C), Classification of Circuit elements, Voltage and Current sources, Source transformation Techniques– Kirchhoff's laws – Star-delta transformation – Network reduction techniques - Mesh and Nodal Analysis for D.C. Circuits– Concept of mutual inductance – Dot convention.

UNIT-II
Network Topology: Graph, tree, incidence matrix, and tie set and cut set matrices – Formulation of equilibrium equations based on graph theory. Duality and dual circuits
A.C. Fundamentals: Periodic waveforms – Average and effective values of different waveforms - Form factor and crest factor.

UNIT-III
A.C. Circuits: Phase and phase difference – Phasor notation – Concept of reactance, impedance, susceptance and admittance – Power factor -Active and reactive power – Impedance Triangle-Power triangle - Steady State analysis of single-phase A.C. circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel) – Phasor diagrams. Mesh and Nodal Analysis for A.C. Circuits.

UNIT-IV
D.C. Machines: Construction of a D.C. Machine, **D.C. Generator:** Operation, Classification and EMF equation. **D.C. Motor:** Operation, Back E.M.F, Types, and Applications.
Single Phase Transformers: Principle of Operation, Types, EMF equation.

UNIT-V
Three Phase Induction Motor: Production of Rotating Magnetic Field, Construction and operation of 3-Phase Induction Motor.
Alternators: Construction and working of Alternators.

Text Books:

1. Sudhakar and Shyammohan, Circuits and Networks: Analysis and Synthesis, 5th Edition, Tata McGraw-Hill
2. Ravish R. Singh, Network Analysis and Synthesis, Tata Mc. Graw Hill.
3. Nagrath and Kothari,Basic Electrical Engineering, 4th Edition, Tata Mc. Graw Hill.
4. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill.

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

1. Understand and analyze basic electric and magnetic circuits.
2. Study the working principles of electrical machines and power converters.
3. Introduce the components of low-voltage electrical installations.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	1	1	1	1	2	2	1	-	-
CO2	3	3	-	-	-	1	1	-	-	1		1	-	-
CO3	3	3	3	3	2	1	1	1	1	1	2	-	-	-

II Semester CS 204 DATA STRUCTURES
(II Semester – for CSE only)
Instruction: 3 hr / week Credits: 3 Assessment: 3

Course objectives:

1. Develop skills to design and analyze linear and nonlinear data structures.
2. Develop algorithms for manipulating linked lists, stacks, queues, trees and graphs.
3. Develop recursive algorithms as they apply to trees and graphs.
4. Strengthen the ability to identify and apply the suitable data structure for the given real world problem
5. Understand the various techniques of sorting and searching

UNIT I

Introduction: Data types/Objects/Structures, Abstract definition of Data Structures, Overview of linear and nonlinear data structures, Analysis of algorithms, Algorithm specification, Asymptotic notation, Time-Space trade-off, Searching: Linear, Binary and Fibonacci search and their complexity analysis.

Arrays: Definition, Multidimensional arrays, Pointer arrays, Representation of arrays – Row major and Column major orders, Application of arrays – Polynomials, Sparse matrices representation.

UNIT II

Stacks and Queues: Introduction, ADT, Array representation, Operations and Applications of Stacks - Evaluation of expressions, Code generation for stack machines, Implementation of recursion, Factorial calculation and Towers of Hanoi; Circular Queue, Priority Queue, Double ended queue, Applications of Queues - Simulation, CPU Scheduling; Multiple stacks and queues

UNIT III

Linked Lists: Singly linked lists and chains, Circular linked list, Doubly linked list, Circular doubly linked list, Complexity analysis of the same, Linked representation of Stacks and Queues, Applications of linked lists - Polynomial representation, Sparse matrix multiplication, Dynamic storage management; Generalized list representation, Recursive algorithms for lists, Recursive lists

UNIT IV

Trees: Basic tree terminologies, Binary trees – Definition, Properties, ADT, Representations, Operations and Applications; Binary Search Trees, Heap Trees, Threaded binary trees, Height balanced trees – AVL Trees, Red black tree, Splay tree Their operations and complexity analysis.

UNIT V

Sorting Techniques: Insertion sort, Selection sort, Bubble sort, Quick sort, Radix sort Merge sort, External sort – Introduction, K-way Merge sort.

Graphs: Basic terminologies, Representations, ADT, Operations on graphs – DFS, BFS, Spanning trees, Biconnected components, Minimum cost spanning trees.

Course Outcomes: After completion of the course the students will be able to

1. Choose appropriate data structure for the specified problem definition.
2. Implement linear and non-linear data structures viz. stacks, queues, linked list, trees, graphs.

3. Apply the concept of trees and graph data structures for the real world problems.
4. Comprehend the implementation of sorting and searching algorithms

Text Books:

1. Ellis Horowitz and Sartaj Sahani, "Fundamentals of Data Structures", Computer Science Press.
2. Ellis Horowitz, Sartaj Sahni and Dinesh Mehta, Fundamentals of Data Structures in C++ Universities Press, Second Edition.
3. Debasis Samanta, Classic Data Structures, Second Edition, Prentice Hall of India

Reference Books:

1. Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein "Data Structures Using C and C++", PHI Learning Private Limited
2. Jean Paul Trembley and Paul G. Sorenson, "An Introduction to Data Structures with applications", McGraw Hill.
3. R. Kruse etal, "Data Structures and Program Design in C", Pearson Education

Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2	2	-	-	-	1	-	-	-	-	-
CO2	3	3	2	3	2	-	2	-	-	-	-	-	-	-
CO3	2	-	2	3	3	1	-	-	-	-	1	-	-	-
CO4	1	2	2	3	-	-	-	-	2	-	-	-	-	-

II Semester CS 207 DATA STRUCTURES LAB

(for CSE only)

Instruction: 2 (Lab) hr / week Credits: 1 Assessment: 3

Course Objectives:

1. To understand the practical application of linear and nonlinear data structures.
2. To develop and execute programs in C++/C to solve problems using data structures such as arrays, linked lists, stacks, queues, trees, and graphs.
3. To develop and execute programs in C to implement various sorting and searching techniques

1. Develop an algorithm to implement stack using arrays. Code it in C++.
2. Develop an algorithm to evaluate a given postfix expression using stack. Code it in C.
3. Develop an algorithm to convert a given infix expression to postfix form using stacks. Code it in C.
4. Develop algorithms to implement i) Linear queue and ii) Circular queue using arrays. Code it in C++.
5. Develop an algorithm to implement double ended queue (de queue) using arrays. Code it in C++.
6. Develop algorithms using dynamic variables and pointers, to construct a singly linked list consisting of the following information in each node: student id (integer), student name (character string) and semester (integer). The operations to be supported are:
    a. Inserting a nodei) at the front of a list ii) at the rear of the list ii) at any position in the list
    b. Deleting a node based on student id. If the specified node is not present in the list, an error Message should be displayed.
    c. Searching a node based on student id. If the specified node is not present in the list an error message should be displayed.
    d. Displaying all the nodes in the list.

7. Develop an algorithm using dynamic variables and pointers to construct a stack of integers using singly linked list and to perform the following operations: Code the same in C++.
    i) Push, ii) Pop iii) Display (The program should print appropriate messages for stack overflow and stack empty). Code the same in C++.
8. Develop an algorithm using dynamic variables and pointers to construct a queue of integers using singly linked list and to perform the following operations:
    a. Insert b. Deletec. Display. The program should print appropriate messages for queue full and queue empty. Code the same in C++.
9. Develop an algorithm to support the following operations on a doubly linked list where each node consists of integer data object:
    a. Create a doubly linked list
    b. Insert a new node
    c. Delete the specific node
    d. Display the contents of the list. Code the same in C++.
10. Develop algorithms to
    a. Construct a binary tree of integers.

b. Traverse the binary tree using inorder, preorder and postorder. (both recursive and non-recursive versions)
c. Display the elements in the tree. Code the same in C++.

11. Develop algorithms to create a binary search tree (BST) and perform the following operations on it. Find (a) Minimum element (b) Maximum element (c) Search for a given element (d) Find predecessor of a node (e) Find successor of a node (f) Delete a node with specific key value. Code the same in C++.
12. Develop an algorithm to construct an AVL tree for the given set of elements. Code it in C++.
13. Develop algorithms to Sort the given list of elements (i.e. numbers or strings)
    (a) Insertion sort (b) Merge sort (c) Quick sort (d) Heap sort Code the same in C.
14. Develop algorithms to implement of graph traversals by applying:
    (a) BFS (b) DFS. Code the same in C/C++.
15. Develop algorithms to find out a minimum spanning tree of a simple connected undirected graph by applying: (a) Prim's algorithm (b) Kruskal's algorithm Code the same in C/C++.

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Identify the appropriate data structure for given problem.
2. Have practical knowledge on the application of data structures.
3. Analyze the time and space efficiency of the data structure.

Text Books:

1. Object Oriented Programming with ANSI & Turbo C++, Ashok N. Kamthane, Pearson Education
2. Scheldt H, C: The Complete Reference, 4th Edition, Tata McGraw-Hill, 2002.
3. Ellis Horowitz, Sartaj Sahni and Dinesh Mehta, Fundamentals of Data Structures in C++ Universities Press, Second Edition.
4. Data Structures using C and C++, Yedidyah Langsam. MosheJ. Augenstein Aaron M. Tenenbaum, 2nd Edition, PHI
5. ADTs, Data Structures and Problem Solving with C++, Larry Nyhoff, Pearson Education.
   (a) Forest ecosystem. (b) Grassland ecosystem

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2	-	-	1	-	-	-	-	-	-	-
CO2	3	3	2	-	2	-		1	-	-	-	-	-	-
CO3	3	2	3	3	-	1	-	-	-	1	-	-	-	-

CE 107 / CE 207 ENVIRONMENTAL SCIENCE ***Audit Course***
(CE 107 for EEE, ECE &CSE) ***No Univ.Exam***
(CE 207 for ChE, CE & ME)
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.
(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 studiesDisaster 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. SanthoshkumarGarg,RajeshawriGarg and RajniGarg, Ecological and Environmental studies, Khanna publishers, 2006
6. Gilbert M, Introduction to Environmental Engineering and Science, Masters Publication by Prentice –Hall of India Private Ltd., 1991
7. William P Cunningham and Mary Ann Cunningham, Principles of Environmental Science, Tata McGraw Hill Publishing Co.Ltd, 2002
8. AmalK.Datta, Introduction to Environmental Science and Engineering, Oxford & IBH Publishing Co.Pvt.Ltd, 2000

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.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	2	2	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	2	2	1	-	-	-	-	-	-	-	-
CO4	-	2	3	1	1	-	-	-	-	-	-	-	-	-

****

SECOND YEAR SYLLABUS

MA301B-Mathematics – III

Instruction: Hours/Week: **3L:1T:0P** Credits**: 4**
Sessional Marks: **40** End Semester Examination Marks: **60**

UNIT – I
Complex analysis - I: Analytical functions - Cauchy- Reimann equations – Construction of Analytic functions-Complex integration - Cauchy's theorem - Integral formula - Evaluation of integrals.

UNIT – II
Complex analysis - II**:** Taylor's and Laurents' series- Transformations- Conformal mapping - Bileneartransformations - Transformation of 1/z, z^2, sin z and cos z.

UNIT – III
Complex anaylasis –III: Singularities - Poles - Residues - Residue theorem – Contour integration- Evaluationof real integrals

UNIT – IV
Partial differential equations - I : Formation of differential equations - Classification - First order linear partialdifferential equations – Legranges' 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 - Heatequation – Laplace's equation.

Text/Reference 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: At the end of this course students will demonstrate the ability to

CO 1: After end of the course, students will be able to understand the analyticity of complex functions and conformal mappings. Apply Cauchy's integral formula and Cauchy's integral theorem to evaluate improper integrals along contours.
CO2: Describe conformal mappings between various plane regions. Apply the concepts of complex analysis in many branches of engineering including the branches of hydrodynamics, thermodynamics, and particularly quantum mechanics.
CO3: compute the residue of a function and use the Residue theory to evaluate a contour integrals or an integral over the real line.

CO4: Formulate Solve/Classify the solutions of partial differential equations Identify linear and nonlinear PDE and solve nonlinear PDE by Charpit;s method.
CO5: Apply variables separable methods to solve boundary value problems. Find the solutions of one-dimensional wave equation, heat equation and Laplace equation.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1	1	-	1	2	1	1	1	3	-	-
CO2	2	1	2	1	1	-	1	2	1	1	1	3	-	-
CO3	2	1	2	1	1	-	1	2	1	1	1	3	-	-
CO4	3	1	3	1	1	-	1	1	1	1	1	3	-	-
CO5	3	2	3	3	1	-	1	2	2	2	2	3	-	-

EC302C-Network Theory

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

UNIT-I

Network Theorems: Superposition Theorem– Reciprocity theorem -Thevenin's and Norton's Theorems – Maximum Power Transfer Theorem- Millman's Theorem —Tellegen's Theorem – Compensation Theorem - Application of these Theorems for D.C. circuits and sinusoidal steady state A.C. circuits, Introduction to ThreePhase Circuits.

UNIT-II

Resonance: Series and Parallel Resonance – Resonant frequency, Half power frequencies, bandwidth and Quality Factor.
Locus diagrams: Current locus diagrams of RL and RC series circuits and two branch parallel circuits.

UNIT-III

Transient Analysis: Time domain analysis of RL, RC, and RLC circuits for D.C. and sinusoidal excitations – Determination of initial conditions – Concept of time constant –Laplace transforms of signals and periodic functions and initial and final value theorems – Transient response of RL, RC, and RLC circuits using LaplaceTransform techniques.

UNIT-IV

Network Functions: One-port and Two-port networks – Driving point and transfer functions of networks – Properties of driving point and transfer functions – Concept of complex frequency, poles and zeros – Time domain response from pole-zero diagram – Restrictions on pole-zero locations.

UNIT-V

Two-port Network Parameters: Open circuit impedance and short circuit admittance parameters – Hybrid andinverse-hybrid parameters – Transmission and inverse transmission parameters – Inter relationships between parameter sets – Series, Parallel, and Cascade connection of two-ports – Conditions for reciprocity and symmetry of two-port networks. Terminated two-port networks – Image parameters.

Text/Reference Books:

1. Sudhakar and Shyammohan: Circuits and Networks: Analysis and Synthesis, 5th Edition, Tata McGraw-Hill
2. Ravish R. Singh: Network Analysis and Synthesis, Tata Mc. Graw Hill.
3. Abhijit Chakrabarti: Circuit Theory Analysis and Synthesis, 7th Revised Edition, Dhanpat Rai & Co
4. M. E. Van Valkenburg; “Network analysis”; Pearson Education, Third Revised Edition.

Course Outcomes:
At the end of this course students will demonstrate the ability to

1. Understand basics electrical circuits with nodal and mesh analysis.
2. Appreciate electrical network theorems.
   Apply Laplace Transform for steady state and transient analysis. Determine different network functions.

Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	-	-	-	-	-	-	-	2
CO2	2	2	2	2	-	-	-	-	-	-	-	2
CO3	2	2	3	2	-	-	-	-	-	-	-	2
CO4	2	2	2	2	-	-	-	-	-	-	-	2

EC303C-Signals and Systems
(Common to EEE, ECE and CSE)

Instruction: Hours/Week: **3L:0T:0P** Credits: **3**
Sessional Marks: **40** End Semester Examination Marks: **60**

UNIT I

Introduction to Signals and Systems:

Definition and classification of signals and systems**,** Basic operations on signals, Elementary signals, Classification of Continuous-Time and Discrete-Time Systems, Basic System Properties, Linear Time- Invariant Systems - Discrete-Time LTI Systems, Convolution Sum, Continuous-Time LTI Systems Convolution Integral. Causal LTI Systems Described by Differential and Difference Equations.

Signal Analysis:

Analogy between vectors and signals, Orthogonal signal space, Signal approximation using orthogonal functions, Mean square error, Closed or complete set of orthogonal functions, Orthogonality in complex functions.

UNIT II

Fourier series and Fourier Transform:

Fourier series Representation of Continuous-Time Periodic Signals, Dirichlet's conditions, Properties of Continuous-Time Fourier Series. Trigonometric Fourier Series and Exponential Fourier Series with examples,Complex Fourier spectrum.

Deriving Fourier Transform from Fourier series, Fourier Transform of standard signals, Fourier Transform ofPeriodic Signals, Properties of Continuous-Time Fourier Transform,
Magnitude-Phase responses, Parseval's theorem, Inverse Fourier transform.

Discrete-Time Fourier Transform – Properties, Inverse Discrete-time Fourier Transform. Introduction to Hilbert Transform.

UNIT III

Convolution and Correlation:

Continuous-time convolution, Convolution sum, Correlation between signals, Cross correlation, Autocorrelation, Properties, Energy spectral density, Power spectral density, Relation between convolution and correlation.

UNIT IV

Behavior of continuous time LTI systems:

Distortion less transmission through a system, signal bandwidth, system bandwidth, Ideal LPF, HPF and BPFcharacteristics, Causality and Poly-Wiener criterion for physical realization, relationship between bandwidth and rise time.

Sampling:

Sampling Theorem, Reconstruction of a Signal from its Samples Using Interpolation, types of sampling-natural sampling, flat- top sampling and impulse sampling, Effect of under sampling - Aliasing.

UNIT V

System Analysis using Laplace and z -Transforms:

Laplace Transform - Region of Convergence – Relation between Laplace and Fourier Transform, Inverse Laplace Transform, Properties, Analysis and Characterization of LTI Systems Using Laplace Transform, Z- Transform -Region of Convergence - Properties, Inverse z-Transform, Analysis and Characterization of LTI Systems Using z-Transforms.

Reference Books:

1. Alan V. Oppenheim, Alan S. Willsky, & S. Hamid Nawab, “Signals and Systems,” PearsonHigher Education, 2nd Ed., 1997.
2. J. G. Proakis and D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms, andApplications”, Pearson, 2006.
3. Simon Haykin and B. Van Veen, “Signals & Systems,” John Wiley and Sons, 2nd Edition, 2007.
4. B.P. Lathi, “Principles of LINEAR SYSTEMS and SIGNALS,” Oxford Univ. Press, Second Edition,International version, 2009.
5. A. Anand Kumar, Signals & Systems, PHI, 2011.
6. H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, 2010.
7. Luis F. Chaparro, “Signals and Systems using MATLAB,” Academic Press, 2011.
8. C. L. Philips, J. M. Parr and Eve A. Riskin, “Signals, Systems and Transforms,” Pearson Education, 4th Edition, 2008.

Course Outcomes: At the end of this course students will have the ability to

1. Differentiate between various types of signals and understand the implication of operations ofsignals
2. Understand and classify systems based on the impulse response behavior of both continuous-timeand discrete-time systems
3. Perform domain transformation from time to frequency and understand the energy distribution as afunction of frequency and also usefulness of convolution for analyzing the LTI systems and understand the concepts of power spectral density through correlation.
4. Solve differential and difference equations with initial conditions using Laplace and Z- transforms.

Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	3
CO2	-	1	-	-	-	2	-	-	-	-	-	-
CO3	-	2	2	-	-	-	-	-	-	-	2	2
CO4	-	2	-	-	-	-	-	-	-	-	-	2

EC304C-ElectroMagnetic Waves and Transmission Lines

Instruction: (Hours/Week) **3L:0T:0P** Credits: **3**
Sessional Marks: **40** End Semester Examination Marks: **60**

UNIT-I

Electrostatic Fields: Coulomb's law, Electric field intensity, Electric fields due to continuous charge distributions, Electric flux density, Gauss's law, Applications of Gauss's law, Electric scalar potential, Relation between E and V, Energy stored in electrostatic field, Electrostatic Boundary conditions, Capacitances.

UNIT-II

Magnetostatic fields: Biot-Savart's law, Magnetic field intensity, Magnetic fields due to continuous current distributions, Magnetic flux density, Ampere's circuital law, Applications of Ampere's circuital law, Magnetic vector potential, Relation between B and A, Energy stored in Magnetostatic field, Magnetostatic Boundary conditions, Inductances.

UNIT-III

Time-Varying EM Fields: Faraday's Law, Transformer EMF, Displacement current, Maxwell's Equationsin Point Form and in Integral Form, Phasor notation for fields, Maxwell's Equations in time harmonic form.**Introduction to waves:** Uniform plane wave, Wave equations, Derivation for $\boldsymbol{\gamma}$**,** solutions for free space- conditions, Derivation for $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$**,** Derivation for $\boldsymbol{\eta}$,

UNIT-IV

EM waves in a homogeneous medium: Wave propagation in lossy dielectrics, Wave propagation in lossless dielectrics, Wave propagation in free space, Wave propagation in good conductors, Skin Depth, Skin Resistance, Polarization, Power, Poynting theorem and Poynting vector.
EM waves in a heterogeneous medium: Reflection of a plane wave at normal incidence: transmission coefficient, reflection coefficient, Reflection of a plane wave at oblique incidence: transmission coefficient,reflection coefficient and Brewster angle in both parallel and perpendicular polarizations.

UNIT-V

Transmission Lines: Transmission line parameters, Transmission line Equations, Input impedance,Reflection coefficient, VSWR and Power of Transmission line, Smith Chart.
Applications of transmission lines: Load matching measurement, Load impedance measurement.

Text/Reference Books:

1. Mathew N.O. Sadiku and S.V. Kulkarni, "Principles of Electromagnetics", Oxford University Press
2. William H. Hayt, John A. Buck, "Engineering Electromagnetics", 8th Edition, McGraw-Hill, 2010.
3. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India
4. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India Education, 2008
5. David K. Cheng, Field and Wave Electromagnetics, Pearson, second edition.

Course Outcomes: At the end of this course students will have the ability to

1. Solve electric field intensity and electric flux density in Electrostatic fields.
2. Solve magnetic field intensity and magnetic flux density in Magnetostatic fields.
3. Analyze Maxwell's equations in static fields, time varying fields, time harmonic fields and studyUniform plane wave characteristics.
4. Compute reflection coefficient and transmission coefficient of waves at media interface.
5. Understand characteristics of high frequency transmission lines and its applications.

Mapping of course outcomes with program outcomes:

PO/ CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	3	-	-	2	-	-	-	-	-	3
CO2	3	-	3	-	-	2	-	-	-	-	-	3
CO3	3	-	3	-	-	2	-	-	-	-	-	3
CO4	3	-	3	-	-	2	-	-	-	-	-	3
CO5	3	3	3	-	-	2	-	-	-	-	-	3

EC305C-Digital Logic Design

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

UNIT I
Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan'sTheorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, CodeConversion.

UNIT II
MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Halfand Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU.

UNIT III
Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM,Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudorandom Binary Sequence generator.

UNIT IV
Clock generation Logic Families and Semiconductor Memories: TTL NAND gate, Specifications,Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.

UNIT V
VLSI Design flow: Design entry, Schematic, FSM & HDL, different modeling styles in VHDL, Datatypes and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

Text / Reference Books:

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd Edition,2006.
4. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989
5. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition 2012.

Course outcomes: At the end of this course students will demonstrate the ability to
1. Design and analyze combinational logic circuits.
2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder.
3. Design & analyze synchronous sequential logic circuits.
4. Use HDL & appropriate EDA tools for digital logic design and simulation.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	1	-	-	-	-	1	2
CO2	3	3	2	2	-	1	-	-	-	-	1	2
CO3	3	3	2	2	-	1	-	-	-	-	1	2
CO4	3	3	2	2	-	1	-	-	-	-	1	1

EC306C-Analog Circuits	
Instruction: Hours/Week: **3L:0T:0P**	Credits: **3**
Sessional Marks: **40**	End Semester Examination Marks: **60**

UNIT-I

General Amplifiers Characteristics: Concept of Amplifier, Voltage gain, Current gain, Power gain, Input and Output resistances, Conversion efficiency, Frequency response, Bandwidth, Distortion,

BJT Amplifiers: Small signal low frequency model of the transistor, Analysis of CE, CB and CC amplifiers,Approximate model analysis, Effects of coupling and bypass capacitors on low frequency response, Hybrid-Π model at high frequencies, Calculation of High-Frequency parameters in terms of Low Frequency parameters, CE short circuit gain, CE current gain with resistive load.

UNIT-II

FET Amplifiers: Small signal model, Analysis of CS, CD and CG amplifiers, comparison of performance of the three configurations, High frequency FET circuits, CS amplifier at high frequencies, CD amplifier athigh frequencies.

Multistage Amplifiers: Types of coupling, Choice of amplifier configuration, overall voltage gain and Bandwidth of n-stage amplifier, Darlington and Bootstrap circuits.

UNIT-III

Feedback amplifiers: Feedback concept, Classification, Effects of negative feedback on gain, Stability, Noise, Distortion, Bandwidth, input resistance and output resistance.

Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), Crystal oscillators.

UNIT-IV

Power Amplifiers: Series-Fed Class-A power amplifiers, Transformer coupled class-A power amplifiers, harmonic distortion, Push-pull amplifiers, Class-B amplifiers, Class-AB operation, Complementary symmetry Push-Pull class-B Power amplifiers, Cross-over distortion.

UNIT-V

Differential amplifier: Basic structure and principle of operation, calculation of differential gain, commonmode gain, CMRR, circuits to improve CMRR, transfer characteristics.

Operational Amplifier: Ideal op-amp characteristics, Op-amp internal circuit, examples of IC op-amps, DC and AC characteristics, Inverting and non-inverting modes of operation, voltage follower.

Text/Reference Books:

1. Millman and Halkias, "Integrated Electronics", McGraw-Hill Co
2. Mottershed, "Electronic devices and circuits", PHI
3. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
4. Salivahanan, "Electronic Devices and circuits", TMH.
5. David A. Bell, "Electronic Devices and circuits", PHI
6. D.Roy Choudary, Shail Bala Jain, "Linear Integrated circuits", New Age International publishers, 2018

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Design and analyze various amplifier circuits.
2. Design sinusoidal oscillators.
3. Understand the functioning of OP-AMP and design OP-AMP based circuits.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	1	-	-	-	-	1	2
CO2	3	3	2	2	-	1	-	-	-	-	1	2
CO3	3	3	2	2	-	1	-	-	-	-	1	2

EC309S- Entrepreneurship and Design Thinking

Instruction: Hours/Week: **3L:0T:0P** Credits: **3**
Sessional Marks: **40** End Semester Examination Marks: **60**

UNIT-I

Introduction to Entrepreneurship and Design Thinking

What is an idea, how to generate an idea, basic requirements to start an enterprise/start-up. Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

Activity: Form into groups and discuss about the requirements to start a business

UNIT-II

Design Thinking Process

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brain storming, product development

Activity: Every student presents their idea in three minutes, every student can present design process in the form of flow diagram/flow chart etc. Every student should explain about product development.

UNIT-III

Innovation

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

UNIT-IV

Product Design

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies.

Activity: Importance of modelling, how to set specifications, Explaining their own product design.

UNIT-V

Design Thinking in Business Processes

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes.

Activity: How to market our own product, About maintenance, Reliability and plan for startup.

Textbooks:

1. Change by design, Tim Brown, Harper Bollins (2009)
2. Design Thinking for Strategic Innovation, Idris Mootee, 2013, John Wiley & Sons.

Reference Books:

1. Design Thinking in the Classroom by David Lee, Ulysses press
2. Design the Future, by Shrrutin N Shetty, Norton Press
3. Universal principles of design- William lidwell, kritinaholden, Jill butter.
4. The era of open innovation – chesbrough.H

Course Outcomes: After completion of the course student will be able to:

1. Able to know the concepts related to Entrepreneurship & design thinking.
2. Explain the fundamentals of Design Thinking and innovation and will equip with design thinking techniques for solving problems in various sectors.
3. Analyse to work in a multidisciplinary environment and Evaluate the value of creativity
4. Formulate specific problem statements of real time issues

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	3	2	3	1	1	3	3	-	1	-
CO2	3	3	3	2	3	1	3	3	3	-	3	-
CO3	2	2	2	3	3	1	1	3	3	-	2	-
CO4	-	2	2	2	3	1	2	3	3	-	1	-

MC310A Constitution of India

Instruction: Hours/Week: **2L:0T:0P** **Credits: 0**
Evaluation Scheme: 100 Marks

UNIT-I

History of Making of the Indian Constitution:

History Drafting Committee, (Composition & Working)

Philosophy of the Indian Constitution:

PreambleSalient 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,

QualificationsPowers and Functions

UNIT-IV

- **Local Administration:**
- District's Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative, CEO of MunicipalCorporation.
- 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: At the end of this course students will demonstrate the

ability to1 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 ofsocial 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 adultsuffrage in the Indian Constitution.Discuss the passage of the Hindu Code Bill of 1956.

Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	2	3		2	1	2	-	-
CO2	-	-	-	-	2	1	1	1	2	2	1	-
CO3	-	-	-	-	1	2	1	2	1	1	1	-

EC307L-Basic Electrical Engineering Laboratory

Instruction: Hours/Week: **0L:0T:3P** Credits: **1.5**
Sessional Marks: **40** End Semester Examination Marks: **60**

List of Experiments:

1. Basic safety precautions, Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope).
3. Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
4. Transformers: Observation of the no-load current waveform on an oscilloscope (non-sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics).
5. Loading of a transformer: measurement of primary and secondary voltages and currents, andpower.
6. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
7. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging
   - slip ring arrangement) and single-phase induction machine.
8. Torque Speed Characteristic of separately excited dc motor.
9. Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super synchronous speed.
10. Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.
11. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the

use ofdc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

Course Outcomes: After completion of the course student will be able to:

CO1: Get an exposure to common electrical components and their ratings.
CO2: Make electrical connections by wires of appropriate ratings.

CO3: Understand the usage of common electrical measuring instruments.

CO4: Understand the basic characteristics of transformers and electrical machines.

Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	2
CO2	2	2	1	1	-	-	-	-	-	-	-	2
CO3	2	2	1	1	-	-	-	-	-	-	-	2
CO4	2	2	1	1	-	-	-	-	-	-	-	2

EC308L-Electronic Devices Laboratory

Instruction: Hours/Week: **0L:0T:3P** Credits: **1.5**
Sessional Marks: **40** End Semester Examination Marks: **60**

Hands-on experiments related to the course contents Electronic Devices LaboratoryList of Experiments:

1. P-N Junction Diode Characteristics
2. Zener Diode Characteristics
3. Half Wave Rectifiers (without and with filter)
4. Full Wave Rectifiers (without and with filter)
5. CB Characteristics
6. CE Characteristics
7. CC Characteristics
8. FET Characteristics
9. BJT Biasing

10.SCR
Characteristics

11.UJT
Characteristics

12.LDR
characteristics

13.LED
Characteristics

14. Photodiode characteristics
15. Phototransistor characteristics.

Some of the experiments can be done using any Simulation Software.

Prerequisites: None

Course Outcomes: After completion of the course student will be able to:

CO1: Plot the characteristics of electronic devices to understand their behaviour.

CO2: Design, construct and test amplifier circuits, Rectifiers, Special devices and interpret theresults.

CO3: Operate electronic test equipment using hardware/software tools to characterize the behaviourof devices and circuits.

Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3	-	-	-	1	2	-	-	3	-
CO2	3	2	3	-	-	-	-	2	-	-	3	-
CO3	3	3	3	3	-	-	-	2	-	-	3	-

EC311L-Simulation Laboratory

Instruction: Hours/Week: **0L:0T:2P**	Credits: **01**
Sessional Marks: **40**	End Semester Examination Marks: **60**

- **All the experiments are to be simulated using MATLAB or equivalent software.**
- **Minimum of 12 - 15 experiments are to be completed.**

List of Experiments:

1. Basic Operations on Matrices.
2. Generation of Various Signals and Sequences (Periodic and Aperiodic), such as UnitImpulse, Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc.
3. Operations on Signals and Sequences such as Addition, Multiplication, Scaling, Shifting,Folding, Computation of Energy and Average Power.
4. Finding the Even and Odd parts of Signal/Sequence and Real and Imaginary parts ofSignal.
5. Convolution for Signals and sequences.
6. Auto Correlation and Cross Correlation for Signals and Sequences.
7. Verification of Linearity and Time Invariance Properties of a given Continuous/DiscreteSystem.
8. Computation of Unit sample, Unit step and Sinusoidal responses of the given LTI systemand verifying its physical realizability and stability properties.
9. Gibbs Phenomenon Simulation.
10. Finding the Fourier Transform of a given signal and plotting its magnitude and phasespectrum.
11. Waveform Synthesis using Laplace Transform.
12. Locating the Zeros and Poles and plotting the Pole-Zero maps in S-plane and Z-Plane for the given transfer function and verify its stability.
13. Generation of Gaussian noise (Real and Complex), Computation of its mean, M.S. Valueand its Skew, Kurtosis, and PSD, Probability Distribution Function.
14. Verification of Sampling Theorem. Write a program to generate discrete time sequenceby sampling a continuous time signal. Show that with sampling rates less than Nyquist rate, aliasing occurs while reconstructing the signal.
15. Write a program to find autocorrelation and cross correlation of given

sequences. Removal of noise by Autocorrelation / Cross correlation.

16. Write a program to verify Linearity and Time Invariance properties of a givenContinuous/Discrete System
17. Extraction of Periodic Signal masked by noise using Correlation.
18. Write a program to find magnitude and phase response of first order low pass and highpass filter. Plot the responses in logarithmic scale.
19. Write a program to find response of a low pass filter and high pass filter, when a speechsignal is passed through these filters.
20. Write a program to generate Complex Gaussian noise and find its mean, variance, Probability Density Function (PDF) and Power Spectral Density (PSD).
21. Generate a Random data (with bipolar) for a given data rate (say 10kbps). Plot the samefor a time period of 0.2 sec.

Prerequisites: None

Course Outcomes: After completion of the course student will be able to:

CO1: Learn how to use the MATLAB software and know syntax of MATLAB programming.CO2: Understand how to simulate different types of signals and system response.
CO3: Find the Fourier Transform of a given signal and plot amplitude and phasecharacteristics.
CO4: Analyze the response of different systems when they are excited by different signalsand plot power spectral density of signals

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3	-	-	-	1	2	-	-	3	-
CO2	3	2	3	-	-	-	-	2	-	-	3	-
CO3	3	3	3	3	-	-	-	2	-	-	3	-
CO4	3	3	3	3	-	-	-	2	-	-	3	-

EC401C-Linear Control Systems

Instruction: Hours/Week: **3L:0T:0P** Credits: **3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Unit-I
Introduction to control problem:

Industrial Control examples, System Representation, Classification of systems, Feedback Control, Benefits of Feedback- Open-Loop and Closed-loop systems, Advantages and Disadvantages of control systems, Industrial Control examples.

Mathematical models of physical systems: Electrical, Mechanical and Electro-Mechanical, Transfer function models of linear time-invariant systems: Potentiometers, Synchros, LVDT, dc and ac servomotors, Tacho- generators, electro hydraulic valves, hydraulic servomotors, electro pneumatic valves, pneumatic actuators. Closed-loop systems, Block diagram algebra, Reduction techniques and Signal flow graph.

Unit-II
Time Response Analysis:

Standard test signals, Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness. Design specifications for second-order systems based on the time-response, Steadystate errors and error constants, Performance specifications in time-domain error, Static and Generalized error constants, Concept of stability, Routh-Hurwitz Criteria, Relative Stability analysis, Root-Locus technique, Construction of Root-loci.

Unit-III
Frequency-response analysis:

Introduction to Frequency domain specifications -Relationship between time and frequency response, Polar plots, Bode plot, stability in frequency domain, Nyquist plots. Nyquist stability criterion. Relative stability usingNyquist criterion – gain and phase margin. Performance specifications in frequency-domain, Frequency domainmethods of design.

Unit-IV
Introduction to Controller Design:
Compensation & their realization in time & frequency domain, Introduction to controllers (PI, PD, PID), Application of Proportional, Integral and Derivative Controllers, Need for Lead and Lag compensators, Applications of compensators, Comparison of controllers and compensators, Problems.

Unit-V
State variable Analysis:
Concepts of state, state variables, State space model for linear continuous time functions, Diagonalization of

State Matrix. Solution of state equations. Eigen values and Stability Analysis. Concept of controllability andobservability.

Text/Reference Books:

1. M. Gopal, “Control Systems: Principles and Design”, McGraw Hill Education, 1997.
2. B. C. Kuo, “Automatic Control System”, Prentice Hall, Seventh edition, 1995.
3. K. Ogata, “Modern Control Engineering”, Prentice Hall, second edition, 1991.
4. I. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International, 2009K. L. Chung.

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Identify the various control system components and their representations.
2. Analyze the various time domain parameters.
3. Analysis the various frequency response plots and its system.
4. Apply the concepts of various system stability criterions and design various transfer functions of digitalcontrol system using state variable models.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	-	-	-	-	-	-	-	2
CO2	2	2	2	2	-	-	-	-	-	-	-	2
CO3	3	2	2	2	-	-	-	-	-	-	-	2
CO4	2	1	2	2	-	-	-	-	-	-	-	2

EC402C-Probability Theory and Stochastic Processes

Instruction: Hours/Week: **3L:0T:0P**	Credits: **3**
Sessional Marks: **40**	End Semester Examination Marks: **60**

UNIT-I

Probability: Sets and set operations, Probability space, Events, Probability Definitions and Axioms, Mathematical Model of Experiments, Joint Probability, Conditional probability, Total Probability, and Bayestheorem, Combinatorial probability and sampling models.

Random Variable: Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete random variables, probability mass function, probability distribution function, example random variables and distributions. Continuous random variables, probability density function, probability distribution function, Properties, Mixed Random Variable, example distributions - Binomial, Poisson, Uniform, Gaussian, Exponential, Raleigh etc.

UNIT-II

Multiple Random Variables: Vector Random Variables, Joint distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, functions of one and two random variables, Conditional Distribution and Density, Methods of defining Conditioning Event, Conditional Density, Properties. Statistical Independence, Sum of Two Random Variables, Sum of Several Random Variables, Markov, Chebyshev and Chernoff bounds.

UNIT-III

Operations on Multiple Random Variables: Expected Value of a Function of Random Variables, momentsof random variable, Characteristic functions of a random variable, Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions and Joint Gaussian Random Variables. Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square), Limit theorems: Strong and weak laws of large numbers, Central Limit Theorem, (Proof not expected), Unequal Distribution, Equal Distributions. Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variables.

UNIT-IV

Random Process– Temporal Characteristics: The Random Process Concept, Classification of Processes,Stationary processes, First-Order Stationery Processes, Second- Order and Wide-Sense Stationarity, (N- Order) and Strict-Sense Stationarity, Mean and covariance functions, Time Averages and Ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes, Autocorrelation Function & Its Properties, Cross- Correlation Function & its Properties, Covariance Functions, Gaussian Random Processes, Poisson RandomProcess.

Random Processes – Spectral Characteristics: Power spectral density, Properties, Relationship between Power Spectrum and Autocorrelation Function, The Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function.

UNIT-V

Transmission of random process through LTI systems: System Response, Convolution, Mean and Mean- squared Value of System Response, autocorrelation Function of Response, Cross-Correlation Functions of Input and Output, Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectrums of Input and Output, properties of white noise, Band pass, Band-Limited and Narrowband Processes, Properties.

Text / Reference Books:

1. H. Stark and J. Woods, Probability and Random Processes with Applications to Signal Processing, 3rdEdition, Pearson Education.
2. Peyton Z. Peebles, Probability, Random Variables & Random Signal Principles, Tata McGraw Hill, 4thEdition, 2001.
3. Athanasios Papoulis and S. Unnikrishnan Pillai, Probability, Random Variables and StochasticProcesses, PHI, 4th Edition, 2002.
4. Hisashi Kobayashi, Brian L. Mark and William Turin, Probability, Random Processes, and StatisticalAnalysis, Cambridge University Press, 2012.
5. John J. Shynk, Probability, Random Variables, and Random Processes Theory and Signal ProcessingApplications, John Wiley & Sons, Inc., Hoboken, New Jersey, 2013, ISBN: 978-0-470-24209-4.

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Understand representation of random signals.
2. Obtain Distribution function, Density functions, and Conditional density functions for different Randomvariables.
3. Make use of theorems related to random signals.
4. Investigate temporal and spectral characteristics of random processes.
5. Able to Model of different Noise Sources and understand propagation of random signals in LTI systems.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**3**	**-**	**-**	**2**
CO2	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**3**	**-**	**-**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**3**	**-**	**-**	**2**
CO4	**3**	**2**	**3**	**3**	**2**	**-**	**-**	**-**	**3**	**-**	**-**	**1**
CO5	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**2**

HS403C-Managerial Economics and Accountancy

Instruction: Hours/Week: 3**L:0T:0P** Credits**: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

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/ Reference Books:

1. Henry Malcom Steiner, Engineering Economics Principles, 2nd Edition, McGraw HillEducation, 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: At the end of this course students will demonstrate the ability to

1. Understand Macro Economic environment of the business and its impact onenterprise.
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.

Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	-	-		2	-	-
CO2	-	-	-	-	-	-	-	-	3	-	3	-
CO3	-	1	-	-	-	-	-	-	-	-	3	-
CO4	2	-	-	-	-	-	-	-	-	-	3	-

EC404C-IC Applications

Instruction: Hours/Week: 3**L:0T:0P** Credits**: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

UNIT – I

Op-Amp Applications: Scale changer/inverter, Summing amplifier, Instrumentation amplifier, Instrumentationamplifier IC-AD620, DC and AC amplifiers, V to I and I to V converters, Precision rectifiers, Log and Antilog amplifiers, multiplier and divider, Analog multiplier IC-AD633, Differentiator, Integrator, Analog computation.

UNIT – II

Comparators and waveform generators: Comparator, Regenerative comparator (Schmitt Trigger), Astable and mono-stable multi-vibrators using op-amp, Triangular wave generator, Sine wave generators using op-amp. ICwaveform generator (8038).

UNIT – III

Voltage regulators: Series op-amp regulator, IC voltage regulators, 723 General purpose regulator, Switching regulators. Active filters: Low pass, high pass, band pass, band reject and all pass filters, transformation, State variable filter, Switched capacitor filters, Switched capacitor filter ICs.

UNIT – IV

555 Timer: Description of functional diagram, Monostable operation. Applications in monostable mode, Astable operation, Applications in astable mode, Schmitt trigger. Phase Locked Loops: PLL-introduction, block schematic, principles and description individual blocks, IC PLL (565), Voltage controlled oscillator (566), PLLapplications- Frequency multiplication, Frequency translation, FM & FSK demodulation.

UNIT – V

D-A and A-D Converters: Basic DAC Techniques, Weighted resistor DAC, R-2R ladder DAC, Inverted R-2R ladder, Monolithic DAC IC-1409, A-D converters, direct type ADCs, the parallel comparator(flash) A/D converter, The counter type A/D converter, Servo tracking A/D converter, Successive approximation converter,Integrating type of ADCs, Charge balancing ADC, Dual-slope ADC, DAC/ADC specifications.

Text/ Reference Books:

1. D.Roy Choudary, Shail Bala Jain, “Linear Integrated circuits”, New Age International publishers, 2018.
2. Ramakant A.Gayakward, “Op-amps and linear Integrated circuits”, LPE, 4th edition, PearsonEducation.
3. S.Salivahanan, V.S.Kanchana Bhaaskaran “Linear Integrated circuits”, TMH, 2008.
4. David A. Bell, “Operational amplifiers and Linear ICs”, PHI, EEE, 1997.
5. 5. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Understand the functioning of OP-AMP and design OP-AMP based circuits.
2. Understand the functioning of voltage regulators and design IC based voltage regulators,
3. Understand the functioning of 555 timer and design 555 timer-based circuits.
4. Understand the functioning of PLL and design PLL based circuits.
5. Design ADC and DAC circuits

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	1	-	-	-	-	1	2
CO2	3	3	2	2	-	1	-	-	-	-	1	2
CO3	3	3	2	2	-	1	-	-	-	-	1	2
CO4	3	3	2	2	-	1	-	-	-	-	1	1
CO5	3	3	2	2	-	1	-	-	-	-	1	1

EC405C-Analog Communications

Instruction: (Hours/Week) **3L:0T:0P** Credits: **3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Unit – I

Introduction: Elements of communication systems, Information, Messages and Signals, Modulation, Modulation Methods, Modulation Benefits and Applications.
Amplitude Modulation & Demodulation: Baseband and carrier communication, Amplitude Modulation (AM), Rectifier detector, Envelope detector, Double sideband suppressed carrier (DSB-SC) modulation & its demodulation, Switching modulators, Ring modulator, Balanced modulator, Frequency mixer, sideband and carrier power of AM, Generation of AM signals, Single sideband (SSB) transmission, Time domain representation of SSB signals & their demodulation schemes (with carrier, and suppressed carrier), Generationof SSB signals, Vestigial sideband (VSB) modulator & demodulator, Frequency division multiplexing (FDM),Illustrative Problems.

UNIT-II

Angle Modulation & Demodulation: Concept of instantaneous frequency, Generalized concept of angle modulation- Frequency Modulation & Phase modulation : Bandwidth of angle modulated waves, Narrow bandfrequency modulation (NBFM) and Wide band FM (WBFM), Verification of Frequency modulation bandwidthrelationship, Features of angle modulation, Generation of FM waves-Indirect method, Direct generation; Demodulation of FM, Band pass limiter, Practical frequency demodulators, Small error analysis, Pre-emphasis,& De-emphasis filters, FM Capture Effect, Illustrative Problems.

UNIT-III

Noise in Communication Systems: Thermal noise, Time domain representation of narrowband noise, filteredwhite noise, Quadrature representation of narrowband noise, Envelope of narrowband noise plus sine wave, Signal to noise ratio & probability of error, Noise equivalent bandwidth, Effective noise temperature, and Noisefigure, Baseband systems with channel noise, Performance analysis (i.e. finding SNR expression) of AM, DSB-SC, SSB-SC, FM, PM in the presence of noise, Illustrative Problems.

UNIT-IV

Radio Receivers: Working principle of Super heterodyne AM and FM Receivers along with suitable block diagrams, Sensitivity, Selectivity and fidelity.

Analog Pulse Modulation Schemes: Pulse amplitude modulation – Natural sampling, flat top sampling and Pulse amplitude modulation (PAM) & demodulation, Pulse-Time Modulation – Pulse Duration and Pulse Position modulations, and demodulation schemes, PPM spectral analysis, Illustrative Problems.

UNIT-V

Information Theory: Introduction, Information and Entropy, and its properties, source coding Theorem, DataCompaction – Prefix coding, Huffman coding, Discrete Memory less channels, Mutual Information, and its properties, Channel capacity, Channel coding Theorem, Application to binary symmetric channels, differential entropy and mutual information, Information capacity theorem, implication of information capacity theorem, Rate Distortion, Illustrative problems

.

Text Books:

1. B. P. Lathi, "Modern Digital and Analog Communication Systems," Oxford Univ. press, 3rd Edition, 2006.
2. Simon Haykin, "Communication Systems," by John Wiley & Sons,3rdEdition, 2010.
3. Sham Shanmugam, "Digital and Analog Communication Systems", Wiley-India edition, 2006.

REFERENCES:

1. Bruce Carlson, & Paul B. Crilly, "Communication Systems – An Introduction to Signals & Noise inElectrical Communication", McGraw-Hill International Edition, 5th Edition, 2010.
2. Herbert Taub&Donald L Schilling, "Principles of Communication Systems", Tata McGraw-Hill, 3rdEdition, 2009.
3. R.E. Ziemer& W.H. Tranter, "Principles of Communication-Systems Modulation & Noise", JaicoPublishing House, 5thedition, 2001.
4. George Kennedy and Bernard Davis, "Electronics & Communication System", TMH,2004.

Course Outcomes: At the end of this course students will have the ability to

CO1: Understand the concepts of various Amplitude, Angle and Pulse Modulation schemes. Understand theconcepts of information theory with random processes. (L1)

CO2: Apply the concepts to solve problems in analog and pulse modulation schemes. (L2)

CO3: Analysis of analog communication system in the presence of noise. (L3)

CO4: Compare and contrast design issues, advantages, disadvantages and limitations of various modulationschemes in analog communication systems. (L4)

CO5: Solve basic communication problems & calculate information rate and channel capacity of a discretecommunication channel. (L5)

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	_	1	1	_	_	_	_	_	1
CO2	2	2	1	_	1	1	_	_	_	_	_	1
CO3	2	2	1	_	1	1	_	_	_	_	_	1
CO4	2	2	1	_	1	1	_	_	_	_	_	-

EC409S- Python Programming

Instruction: (Hours/Week) **1L:0T:2P** Credits: **2**
Evaluation Scheme: **100 Marks**

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, andreverse, 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 & Objects

Classes in Python, Principles of Object-Oriented programming, Creating Classes, Instance Methods, File Organization, Special Methods, Class Variables, Inheritance, Polymorphism, Type Identification, CustomException 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

Text Books:

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, HigherEducation 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, MichealS Goldwasser, Wiley Publisher (2016)
4. Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material CourseTechnology Inc. 1 st edition (6th February 2009)

REFERENCES:

1. Dive into Python, Mike 2. Learning Python, 4th Edition by Mark Lutz 3. Programming Python, 4th Edition by Mark L
2. Fundamentals of Python Programming, Richard L. Halterman Updated content of the book ismaintained under the URL:http://python.cs.southern.edu/pythonbook/pythonbook.pdf
3. 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
4. How to think like a computer scientist http://openbookproject.net/thinkcs/python/english3e/
5. Code Academy Python http://www.codecademy.com/tracks/python
6. A useful hands-on book: http://anh.cs.luc.edu/python/hands-on/3.1/Hands-onPythonTutorial.pdf

Course Outcomes: At the end of this course students will have the ability 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.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

EC406L-Digital Logic Design Laboratory

Instruction: Hours/Week: **0L:0T:3P** Credits: **1.5**
Sessional Marks: **40** End Semester Examination Marks: **60**

LIST OF EXPERIMENTS

1. Realization of Boolean Expressions using Gates
2. Design and realization of logic gates using universal gates
3. Design and realization of a 4 – bit Gray to Binary and Binary to Gray Converter
4. Verify the functionality of Mux and Decoder ICs
5. Design and realization of 4-bit comparator
6. Verify the functionality of Flip-Flop ICs
7. Mod-N counter using 7490 and 74190.
8. Shift register IC 7495.

Note: Implement using digital ICs.VHDL Programming:

1. Write structural and dataflow VHDL models for
a) 4-bit ripple carry adder. b) 4-bit carry Adder – cum Subtractor.
c) 2-digit BCD adder /subtractor d) 4-bit carry look ahead adder e) 8-bit comparator

2. Write a VHDL program in structural model for
a) 16:1 mux realization b) 3:8 decoder realization through 2:4 decoder

3. Write a VHDL program in behavioral model for
a) 16:1 mux b) 3:8 decoder c) 8:3 encoder d) 8 bit parity generator and checker

4. Write a VHDL program in structural and behavioral models for
a) 8 bit asynchronous up-down counter b) 8 bit synchronous up-down counter

5. Write a VHDL program for 4-bit sequence detector through Mealy and Moore state machines.

6. Write a VHDL program in behavioral model for 8-bit shift and add multiplier.

7. Write a VHDL program in structural model for 8-bit Universal Shift Register.

Some of the experiments can be done using any Simulation Software.

Course Outcomes: At the end of this course students will have the ability to

1. Construct Basic combinational Circuits and Verification of its functionality
2. Construct Sequential Circuits and Verification of its functionality
3. Write structural, behavioral and data flow models for digital circuits
4. Simulate VHDL models of digital circuits

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	1	-	-	-	-	1	2
CO2	3	3	2	2	-	1	-	-	-	-	1	2
CO3	3	3	2	2	-	1	-	-	-	-	1	2
CO4	3	3	2	2	-	1	-	-	-	-	1	1

EC407L-Analog Circuits Laboratory

Instruction: Hours/Week: **0L:0T:3P** Credits**: 1.5**
Sessional Marks: **40** End Semester Examination Marks: **60**

Hands-on experiments related to the course contents Analog Circuits.
Prerequisites: Electronic Devices Laboratory.

Course Outcomes:

After completion of the course student will be able to:

List of Experiments:

1. Common Emitter Amplifier.

2. Common Collector amplifier

3. Two Stage RC coupled amplifier

4. Voltage series feedback amplifier

5. Voltage shunt feedback amplifier

6. Current series feedback amplifier

7. Current shunt feedback amplifier

8. RC phase shift oscillator

9. Wien bridge oscillator

10. LC/ crystal oscillator.

11.Class A Power Amplifier (Transformer

less) 12.Class B Complementary Symmetry

Amplifier12.Differential amplifier

13.Operational amplifier as (i) Inverting amplifies, (ii) Non-Inverting amplifier (III) Voltagefollower

Some of the experiments can be done using any Simulation Software.

Course Outcomes:
At the end of this course students will have the ability to

1. Know about the usage of equipment/components/software tools used to conduct the experiments in analog circuits.
2. Conduct the experiment based on the knowledge acquired in the theory about various analogcircuits using BJT/MOSFETs to find the important parameters of the circuit (viz. Voltage gain, Current gain, bandwidth, input and output impedances etc) experimentally.
3. Analyze the given analog circuit to find required important metrics of it theoretically and Compare the experimental results with that of theoretical ones and infer the conclusions.
4. Draw the relevant graphs between important metrics of the system from the observed measurements.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	1	-	-	-	-	1	2
CO2	3	3	2	2	-	1	-	-	-	-	1	2
CO3	3	3	2	2	-	1	-	-	-	-	1	2
CO4	3	3	2	2	-	1	-	-	-	-	1	2

EC408L-IC Applications Laboratory

Instruction: Hours/Week: **0L:0T:3P** Credits**: 1.5**
Sessional Marks: **40** End Semester Examination Marks: **60**

Hands-on experiments related to the course contents

EC408L.List of Experiments:

1. Study and Operation of IC testers, pulse generator and digital trainer.
2. Frequency response of inverting and non-inverting amplifier.
3. Measurement of Op.amp parameters: (i) Offset voltage (ii) Offset current (iii) CMRR and (iv)Slew rate
4. Op-amp monostable and astable multivibrators.
5. Design 2's complement adder/subtractor using IC74283 and verify experimentally.
6. Low voltage regulator IC 723.
7. 555 timer: Monostable and astable multivibrators.
8. IC PLL (565) applications- Frequency multiplication, Frequency translation, FM & FSKdemodulation.
9. Voltage controlled oscillator (566)

Course Outcomes: After the completion of the course the student will be able to

1. Measure the parameters of IC 741 Op-amp.
2. Design applications of IC 741 Op-amp
3. Realize analog filters using Op-amp.
4. Design multivibrators using 555 IC.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	1	-	-	-	-	1	2
CO2	3	3	2	2	-	1	-	-	-	-	1	2
CO3	3	3	2	2	-	1	-	-	-	-	1	2
CO4	3	3	2	2	-	1	-	-	-	-	1	1

THIRD YEAR SYLLABUS

EC501C- Computer Organization & Architecture

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Overview: It is important to understand Computer Architecture in order to structure a program so that it runs efficiently on a real machine. When selecting a system to use, it is important to understand the tradeoff among various components, so you can accurately compare competing systems, and understand technical literature on new computer systems. This course will cover the basic concepts of Computer organization and its Architecture that are important for you to understand, including the CPU control and data-path, memory systems including caching and virtual memory, and input/output subsystems.

Prerequisite Courses: Digital Logic Design

Course Objectives: The purpose of the course is

1. To understand the structure of a computer and its operations.
2. To understand the RTL and Micro-level operations and control in a computer.
3. Understanding the concepts of computer arithmetic, instruction set design, micro-programmed control unit, pipelining and vector processing, I/O Systems and memory organization, and operating systems.

UNIT - I:

Basic Structure of Computers: Computer Types, Functional Unit, Basic Operational Concepts, Bus Structures, Software, Performance, Multiprocessors and Multi Computers, Data Representation, Fixed Point Representation, Floating – Point Representation.

Register Transfer Language and Micro Operations: Register Transfer Language, Register Transfer Bus and Memory Transfers, Arithmetic Micro Operations, Logic Micro Operations, Shift Micro Operations, Arithmetic Logic Shift Unit, Instruction Codes, Computer Registers Computer Instructions – Instruction Cycle, Memory – Reference Instructions, Input – Output and Interrupt, STACK Organization, Instruction Formats, Addressing Modes, DATA Transfer and Manipulation, Program Control, Reduced Instruction Set Computer.

UNIT - II:

Micro Programmed Control: Control Memory, Address Sequencing, Microprogram Examples, Design of Control Unit, Hard Wired Control, Microprogrammed Control.

The Memory System: Basic Concepts of Semiconductor RAM Memories, Read-Only Memories, Cache Memories Performance Considerations, Virtual Memories Secondary Storage, Introduction to RAID.

UNIT - III:

Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer Modes, Priority Interrupt, Direct Memory Access, Input –Output Processor (IOP), Serial Communication; Introduction to Peripheral Components, Interconnect (PCI) Bus, Introduction to Standard Serial Communication Protocols like RS232, USB, IEEE 1394.

UNIT - IV:
Operating Systems Overview: Overview of Computer Operating Systems Functions, Protection and Security, Distributed Systems, Special Purpose Systems, Operating Systems Structures-Operating System Services and Systems Calls, System Programs, Operating Systems Generation.
Memory Management: Swapping, Contiguous Memory Allocation, Paging, Structure of The Page Table, Segmentation, Virtual Memory, Demand Paging, Page-Replacement Algorithms, Allocation of Frames, Thrashing Case Studies - UNIX, Linux, Windows.
Principles of Deadlock: System Model, Deadlock Characterization, Deadlock Prevention, Detection and Avoidance, Recovery from Deadlock.

UNIT - V:
File System Interface: The Concept of a File, Access Methods, Directory Structure, File System Mounting, File Sharing, Protection.

File System Implementation: File System Structure, File System Implementation, Directory Implementation, Allocation Methods, Free-Space Management.

Text Books:
1. Computer Organization – Carl Hamacher, Zvonks Vranesic, Safea Zaky, 5th Edition, McGraw Hill.
2. Computer Systems Architecture – M. Moris Mano, IIIrd Edition, Pearson
3. Operating System Concepts- Abraham Silberchatz, Peter B. Galvin, Greg Gagne, 8th Edition, John Wiley.

References:
1. Computer Organization and Architecture – William Stallings Sixth Edition, Pearson
2. Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition PHI
3. Fundamentals of Computer Organization and Design - Sivaraama Dandamudi Springer Int. Edition.
4. Operating Systems – Internals and Design Principles, Stallings, sixth Edition–2009, Pearson Education.
5. Modern Operating Systems, Andrew S Tanenbaum 2nd Edition, PHI.

Course Outcomes: After the completion of the course the student will be able to:
1. Visualize the organization of different blocks in a computer.
2. Use micro-level operations to control different units in a computer.
3. Have knowledge about the organization of Arithmetic and Logical unit and I/O unit.
4. Understand the design of Memory unit, and the overview of computer system hardware and learn about major activities of an Operating systems in a computer with regard to file management, and operating system functions.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	2	1	1	1	-	-	-	1	-	-	2	-	-
CO2	3	3	2	2	1	-	-	-	1	-	-	2	-	-
CO3	2	2	2	2	1	-	-	-	1	-	-	2	1	-
CO4	3	2	3	3	1	-	-	-	1	-	-	1	-	-

EC502C Microprocessors and Microcontrollers

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Overview: The purpose of this course is to teach students the fundamentals of Microprocessor and Microcontroller systems. The student will be able to incorporate these concepts into their electronic designs for other courses where control can be achieved via a Microprocessor / Microcontroller implementation.

This course will start with a discussion on a simple microprocessor, 8085. Understanding this architecture is the basis to follow any other complex CPU architecture. It will be followed by a complete overview of a range of microcontrollers covering 8051, PIC, AVR and ARM. The hardware intricacies of these processors and their programming will be covered.

Pre-requisite Courses: Digital Logic Design, Analog Circuits.

Course Objectives: The purpose of the course is

1. To familiarize the Architecture, Instructions and Timings of microprocessors and micro controllers.
2. To introduce 8051 architecture and programming of microcontrollers.
3. To provide the knowledge about interfacing techniques of I/O and memory.
4. To understand the concepts of ARM architecture and Advanced ARM processors.

Unit -I

Overview of microcomputer systems and their building blocks, Introduction to 8-bit microprocessor (8085) Architecture, addressing modes, Instruction set, Machine cycles, instruction cycle and timing states, instruction timing diagrams, simple programs in 8085.

Unit -II

Semiconductor memories: RAM, ROM, SRAM, and DRAM. Memory interfacing, concepts of interrupts and Direct Memory Access.

8086 microprocessor – Architecture, Instruction set, Addressing modes, Interrupt system. Minimum mode 8086 system, Maximum mode 8086 system and timing diagrams. Concepts of virtual memory, Cache memory, Architectures of 286, and 386 processors.

Unit -III

8051 Microcontroller: Architecture, register set, addressing modes, Instruction set, Interrupt structure, I/O ports functions, timer and serial port operations, External memory interfacing with 8051.

Assembly language programming of 8051, Parallel I/O Ports, Interrupts, Timer and Counter, Serial Communication Programming.

Unit -IV

I/O interfacing: LED, LCD, Keyboard, Stepper motor, DC Motor, ADC, DAC Interface to 8051. Assemblers and compilers, C language programs, Programming and debugging tools.

Serial Communication and Bus Interface: Serial Communication Standards, Serial Data Transfer Scheme, Onboard communication interfaces - I2C, SPI, and CAN; External communication interfaces - 9-pin RS-232, USB, Bluetooth, Wi-Fi, and ZigBee. Architectures of PIC, Architecture of AVR.

Unit -V

ARM 32-bit Microcontroller: Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, debugging support, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence. (Text 5: Ch 1, 2, 3)

Text/Reference Books:

1. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing, 1996. (UNIT I).
2. D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface", Morgan Kaufman Publishers. (UNIT II).
3. Barry B. Brey, The Intel Microprocessors 8086/8088, 80, 86, 80286, 80386 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, Architecture, Programming and interfacing, Prentice Hall of India Private Limited, New Delhi, 2003, Pearson Education, 2004. (UNIT II).
4. Kenneth J. Ayala, "The 8051 Microcontroller Architecture, Programming and Applications", Penram International Publishing/ Thomson Publishers, 2nd Edition, 2005.
5. Joseph Yiu, The Definitive Guide to the ARM Cortex-M3‖, 2nd Edition, Newnes, (Elsevier), 2010. (UNIT V).

Course Outcomes: Upon completing this course, the student will have the ability to:

1. Do assembly language programming.
2. Do interfacing design of peripherals like, I/O, A/D, D/A, timer etc and develop systems using different microcontrollers.
3. Understand the usage of Communication interfaces with Microcontrollers.
4. Understand design ARM / PIC Microcontroller-based systems.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**3**	**-**	**-**	**2**	**-**	**-**
CO2	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**3**	**-**	**-**	**2**	**1**	**-**
CO3	**2**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**3**	**-**	**-**	**2**	**-**	**-**
CO4	**3**	**2**	**3**	**3**	**2**	**-**	**-**	**-**	**3**	**-**	**-**	**1**	**-**	**1**

EC503C-Digital Signal Processing

Instruction : Hours/Week : **3L:0T:0P** **Credits: 3**

Sessional Marks : **40** End Semester Examination Marks: **60**

Course Description:

The course covers theory and methods for digital signal processing including basic principles governing the analysis and design of discrete-time systems as signal processing devices. Analyze the digital signals using various digital transforms DFT,FFT etc. Review of discrete-time linear, time-invariant systems, Fourier transforms and z-transforms. Introduction to Multirate signal processing, TMS DSP processors.

Course Learning Objectives:

1. To describe signals mathematically and understand how to perform mathematical operations on signals.
2. It will provide knowledge of Digital filter.
3. Design and develop the basic digital system.
4. To discuss multi rate signal processing and applications.
5. Knowledge on TMS DSP processors and their applications.

Unit -1

Discrete Fourier Transform:

Review of Discrete-time Fourier Transform, Z-Transform, Discrete Fourier transform – Properties, linear convolution, circular convolution of sequences using DFT. Computation of DFT.

Fast Fourier Transforms: Fast Fourier transforms (FFT)-Radix2 decimation in time and decimation in frequency FFT algorithms, inverse FFT and FFT for composite N.

Unit-2

IIR Digital Filters: Analog filter approximations-Butterworth and Chebyshev, design of IIR digital filters from analog filters, design examples: analog-digital transformations. Realization structures for IIR filters – direct, canonic, cascade, parallel forms.

Unit-3

FIR Digital Filters: Characteristics of FIR digital filters, frequency response. Design of FIR digital filters using window techniques, frequency sampling technique. Realization structures of FIR Filter - Transversal, Poly-phase and Linear phase structures. comparison of IIR and FIR filters.

Unit -4

Multirate Digital Signal Processing Fundamentals: Basic sample rate alteration devices, Multirate Structures for sampling rate Converters, Multistage design of decimator and Interpolator, Polyphase Decomposition.

Unit -5
DSP PROCESSORS:
Architecture of TMS320C5X: Introduction, Bus structure, Central Arithmetic Logic Unit, Auxiliary Register ALU, Index Register, Block Move Address Register, Parallel Logic Unit, Memory mapped Registers, Program controller, some flags in the status registers, On-chip memory, On-chip peripherals.

Text Books

1. John G. Proakis, Dimitris G.Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Pearson Education/PHI, 4th ed., 2007.
2. Sanjit K Mitra, "Digital Signal Processing: A computer-based approach", Tata Mcgraw Hill, 3rd edition, 2009.
3. A.V. Oppenheim and R.W. Schaffer, "Discrete Time Signal Processing", Prentice Hall of India.
4. B. Venkataramani, M.Bhaskar, Digital Signal Processors: Architecture, Programming and Applications, Tata McGraw Hill, 2002.
5. Handouts on DSP Processors.
6. Texas Instruments DSP Processor user manuals and application notes

Course Outcomes:
Students must be able to:
CO1: Apply DFT for the analysis of digital signals and systems
CO2: Design IIR and FIR filters
CO3: Design the Multirate Filters
CO4: Analyze and apply suitable DSP algorithm for specific application

Mapping of course outcomes with the program objectives:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	-	3	2	-	-	-	-	-	-	2	**3**	**-**	1
CO2	-	3	3	-	-	-	-	-	-	-	3	**2**	**-**	1
CO3	2	-	2	2	-	-	-	-	-	-	2	**-**	**-**	**-**
CO4	2	-	2	2	-	3	2	2	-	-	3	**-**	**-**	**-**

EC504C- Antennas & Wave Propagation

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Pre-requisite: Electromagnetic Theory and Transmission Lines .

Course Description: 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: The course objectives are:

1. To understand the concept of radiation, antenna definitions and significance of antenna parameters, to derive and analyze the radiation characteristics of thin wire dipole antennas and solve numerical problems.
2. To analyse the characteristics and design relations of UHF, VHF and Microwave Antennas.
3. To identify the antenna array requirements, to determine the characteristics of ULAs and estimate the patterns of BSA, EFA, and Binomial Arrays.
4. To understand the concepts and set-up requirements for microwave measurements, and familiarize with the procedure to enable antenna measurements.
5. To define and distinguish between different phenomenon of wave propagation (ground wave, space wave and sky wave), their frequency dependence, and estimate their characteristics, identifying their profiles and parameters involved.

UNIT-I

Antenna Basics: Basic Antenna Parameters – Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity-Gain-Resolution, Antenna Apertures, Effective Height. Fields from Oscillating Dipole, Field Zones, Front - to-back Ratio, Antenna Theorems, Radiation ,Retarded Potentials– HelmholtzTheorem

Thin Linear Wire Antennas – Radiation from Small Electric Dipole, Quarter Wave Monopole and Half Wave Dipole – Current Distributions, Field Components, Radiated Power, Radiation Resistance, Beam Width, Directivity, Effective Area and Effective Height, Natural Current Distributions, Far Fields and Patterns of Thin Linear Centre-fed Antennas of Different Lengths. Loop Antennas.

UNIT-II

Antenna Arrays: Point Sources – Definition, Patterns, arrays of 2 Isotropic Sources - Different Cases, Principle of Pattern Multiplication, Uniform Linear Arrays – Broadside Arrays, End fire Arrays, EFA with Increased Directivity, Derivation of their Characteristics and Comparison, BSAs with Non-uniform Amplitude Distributions – General Considerations and Binomial Arrays.

UNIT-III

VHF, UHF and Microwave Antennas - I: Arrays with Parasitic Elements, Yagi-Uda Array, Folded Dipoles and their Characteristics, Helical Antennas – Helical Geometry, Helix Modes, Practical Design Considerations for Monofilar Helical Antenna in Axial and Normal Modes, Horn Antennas – Types, Fermat's Principle, Optimum Horns, Design Considerations of Pyramidal Horns.

UNIT-IV

VHF, UHF and Microwave Antennas - II: Microstrip Antennas – Introduction, Features, Advantages and Limitations, Rectangular Patch Antennas – Geometry and Parameters, Characteristics of Microstrip Antennas. Reflector Antennas – Introduction, Flat Sheet and Corner Reflectors, Paraboloidal Reflectors – Geometry, Pattern Characteristics, Feed Methods, Reflector Types – Related Features.

UNIT-V

Ground Wave Propagation –Plane Earth Reflections, Space and Surface Waves, Wave Tilt, Curved Earth Reflections. Space Wave Propagation –Field Strength Variation with Distance and Height, Effect of Earth's Curvature, Absorption, Super Refraction, M-Curves and Duct Propagation, Scattering phenomena, Troposphere Propagation. Sky Wave Propagation –Structure of Ionosphere, Refraction and Reflection of Sky Waves by Ionosphere, Ray Path, Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation between MUF and Skip Distance, Multi-hop Propagation.

Text/Reference Books:

1. Antennas and Wave Propagation – J.D. Kraus, R.J. Marhefka and Ahmad S. Khan, TMH, New Delhi, 4th ed., (Special Indian Edition), 2010.
2. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd edition,2000.
3. Antenna Theory - C.A. Balanis, John Wiley & Sons, 3rd Ed., 2005.
4.. Antennas and Wave Propagation – K.D. Prasad, Satya Prakashan, Tech India Publications, New Delhi, 2001.

Course outcomes: At the end of this course students will have the ability to

CO1: Understand the basic parameters of antenna (L1) and apply the concepts to various antennas based on frequency, configuration and establish the radiation patterns of antenna arrays (L2)
CO2: Analysis of VHF, UHF and Microwave Antennas (L3)
CO3: Design and analysis of microstrip antennas (L4)
CO4: To understand the wave propagation in different frequency ranges (L5)

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	2	1	-	1	-	2	1	2	1	3	3	-	-
CO2	3	3	2	2	1	2	3	2	2	1	3	3	-	1
CO3	3	2	2	2	1	2	3	1	1	1	2	3	-	1
CO4	3	3	2	3	2	2	3	-	1	1	2	3	-	1

EC504C -DIGITAL COMMUNICATIONS

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Overview:

Digital Communications is a fundamental course in the stream of Electronics and Communication Engineering. This course introduces the basic concepts and principles involving in the analysis of a digital communication system including various Modulation techniques, concepts involved at the Matched filter, ISI, Signal space analysis, various digital modulation techniques and error detection and correction methods. All modern communication systems uses these concepts as fundamentals to design, operate the same. This course helps students comprehend respective Engineering competitive examinations such as GATE, IES etc.,

Course Objectives:

1. To understand the key modules of digital communication systems with emphasis on its modulation techniques
2. To analyze Matched filter, Inter-symbol interference, correlative level coding concepts
3. To understand signal space analysis to understand geometric representation of signals
4. To Understand generation and detection of various digital modulation schemes
5. To get introduced to the concept and basics of information theory and Error detection and correction codes.

UNIT I

Digital Coding of Analog Waveforms: Sampling, Quantization, Quantization noise, Encoding, Pulse Code Modulation, Regeneration, Decoding & Filtering, Noise considerations in PCM systems, Time-Division Multiplexing, Synchronization, Differential encoding, Delta Modulation, Differential Pulse Code Modulation, Processing gain, Adaptive Delta Modulation,

UNIT II

Baseband Pulse Transmission: Matched filter and it’s Properties, Matched filter for rectangular pulse, Error rate due to noise, Inter-symbol Interference, Nyquist’s criterion for distortion-less baseband binary transmission, Duo binary, Modified duo binary in Correlative-level coding, Baseband M-array PAM transmission, Eye patterns. .

UNIT III

Signal Space Analysis: Introduction, Geometric representation of signals, Gram-Schmidt Orthogonalization procedure, Response of bank of correlators in noise, Coherent detection of signals in noise, Correlation receiver, Probability of error.

UNIT IV

Digital Modulation Techniques: Introduction, Pass band transmission model, ASK, Coherent Phase Shift Keying – Binary phase shift keying, Quadrature shift keying, Binary Frequency shift keying, M-array Quadrature Amplitude Modulation, Non-coherent orthogonal modulation schemes-Differential PSK, Non-Coherent Binary FSK.

(Error probability, Generation and Detection, Power spectra, Bandwidth above schemes)

UNIT-V

Error Control Coding: Introduction, Examples of Error Control Coding, Methods of controlling Errors, Types of Errors, Types of Codes. Linear Block Codes: Matrix Representation of Linear Block Codes, Error Detection and Error Correctio Capabilities of Linear Block Codes. Convolution Codes: Encoders for Convolution Codes, Decoders for Convolution Codes. Illustrative Problems.

TEXT BOOKS

1. Simon Haykin, "Communication Systems," by John Wiley & Sons,3rd Edition, 2010.
2. Sam Shanmugam, "Digital and Analog Communication Systems", Wiley-India edition, 2006.

REFERENCES:

1. B. P. Lathi, "Modern Digital and Analog Communication Systems," Oxford Univ. press, 3rd Edition, 2006.
2. J.S. Chithode, "Digital Communications", Technical Publications, Ist Edition, 2020
3. Bruce Carlson, & Paul B. Crilly, "Communication Systems – An Introduction to Signals & Noise in Electrical Communication", McGraw-Hill International Edition, 5th Edition, 2010.

Course Outcomes:

1. Understand the Digital communication System and able to analyse the different Digital modulation techniques.
2. Understand the concepts of baseband digital modulation schemes and Inter Symbol Interference.
3. Analyze Signal space concepts, probability of error performance of various digital binary modulation systems and are able to design digital communication systems.
4. Design a system with Error correcting codes by learning Block Codes, Cyclic Codes and Convolutional Codes.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	-	-	-	-	-	-	-	-	1	1
CO2	2	1	1	2	-	-	-	-	-	-	-	-	-	1
CO3	1	1	1	1	-	-	-	-	-	-	-	-	-	1
CO4	1	1	1	2	1	-	-	-	-	-	-	1	-	1

EC506L -Analog and Digital Communication Laboratory

Instruction: Hours/Week: **0L:0T:3P** Credits: **1.5**

Sessional Marks: **40** Semester Examination Marks: **60**

Course Description:

This course gives students deep knowledge in Analog and Digital communication systems at the practical level so that students can understand the logical, analytical, and mathematical background of the communication system. This lab focuses on understanding the fundamental concepts of signal flow in Analog and Digital communication system. The Detailed analysis of AM, FM, Pulse modulations, digital modulation techniques, sampling and reconstruction, Data Conditioning and Reconditioning are done. The course covers the basic types of Analog and Digital modulation in both Simulink and equipment based.

Course Objectives

1. The course gives students deep knowledge in analog and digital communication systems at the practical level.
2. The course aims to make the student familiar with Analog and Digital Modulation and Demodulation techniques, transmission, reception etc.
3. The Course aims to write and simulate the MATLAB code to study the modulation techniques.
4. The Couse enhance the understanding theory of Analog and Digital Communication concepts.

Hands-on experiments related to the course contents ECPCT404.

List of Experiments:

1. Fourier Synthesis
2. AM Transmitter & Receiver
3. FM Transmitter & Receiver
4. AM/FM Radio Receiver
5. Analog signal sampling & Reconstruction
6. Generation & Detection of PAM/PWM/PPM
7. Generation & Detection of PCM
8. Generation & Detection of DM/SIGMA DELTA/ ADM
9. Baseband digital data transmission
10. Data conditioning & Reconditioning
11. Generation & Detection of BPSK/DPSK/DEPSK

12. Simulation of digital modulation schemes

(i) Phase Shift Keying (PSK), differential phase shift keying (DPSK), DEPSK

(ii) QPSK, M-ary PSK, Quadrature Amplitude Modulation (QAM)

Course Outcomes:

After the completion of the course the student will be able to:
1. Generate AM and FM signals and evaluate their performance.
2. Perform signal sampling by determining the sampling rates for baseband signals and reconstruct the signals.
3. Generate digital modulation signals for ASK, PSK and FSK and perform their detection.
4. Simulate MSK, DPSK, QPSK and DEPSK schemes and estimate their BER.

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	3	3	-	-	-	3	-	-	-	3	3
CO2	3		2	2	3	-	-	-	1	-	-	-	3	3
CO3	2	2	3	3	3	-	-	-	2	-	-	-	2	3
CO4	2	2	3	3	3	-	-	-	2	-	-	-	2	3

EC507L Microprocessors and Microcontrollers Laboratory

Instruction : Hours/Week : **0L:0T:3P** Credits: **1.5**

Sessional Marks : **40** Semester Examination Marks: **60**

Course Overview: This course introduces the assembly language programming of 8085 and 8051 Microcontroller. It gives a practical training of interfacing the peripheral devices with the 8085 microprocessor/ 8051microcontroller. It is useful for developing students to be proficient in the assembly language programming skills and real time applications of Microprocessor as well as microcontroller.

Course Objectives: The purpose of the course is

1. To expose students to the operation of typical microprocessor (8085) and microcontroller (8051) trainer kits.
2. To prepare the students to be able to solve different problems by developing different programs.
3. To develop the building of Microcontroller based systems.

Hands-on experiments related to the course contents EC502C.
Pre-requisites: None

Every student is free to do his / her choice of experiments in the Laboratory. Student can do at least 10 to 12 experiments only.

List of Experiments:

(8085/8086 Microprocessor Assembly Language Programming)

1. Write a simple program for arithmetic operations – addition, subtraction, multiplication and division of 16 – bit number.
2. Write a simple program for string operations like string concatenation, swapping.
3. Write a program for interfacing LCD with 8085 and display a message.
4. Write a program for interfacing Stepper Motor with 8085.
5. Write a program for flashing LEDs using 8253 /8254 (PIT) and interrupts.

(8051 Microcontroller Assembly Language Programming)

6. Write a program for performing simple arithmetic operations.
7. Write a program for performing simple Logical operations.
8. Write a simple program for flashing LEDs using software delays, timers and interrupts.
9. Write a program for interfacing Seven Segment Display / LCD with 8051 and display messages.
10. Write a program for interfacing Keypad with 8051 and display keypad input on LCD.

11. Write a program for square waveform generation, with different frequencies and duty cycles.
12. Write a program for serial communication through UART using polling and interrupt methods.
13. Write a program for interfacing ADC with 8051.
14. Write a program for Pulse Width Modulation using on-chip PWM and analog I/O modules.

Write a program for interfacing Seven Segment Display and/or LCD to ARM or 8086 processor.

Course Outcomes: After the completion of the course the student will be able to:

1. Write assembly language programmes for arithmetic and Logical operations using 8085 µp.
2. Develop assembly language programs / C and C++ programs using microcontrollers.
3. Write 8051 assembly language programs to control inbuilt timer and communication modules.
4. Interface ADC and DAC modules with microprocessor-based systems and Write assembly language programmes using ARM / 8086 processor.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**3**	**-**	**-**	**2**	**-**	**-**
CO2	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**2**	**3**	**-**	**-**	**2**	**1**	**-**
CO3	**2**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**3**	**-**	**-**	**2**	**-**	**1**
CO4	**3**	**2**	**3**	**3**	**2**	**-**	**-**	**-**	**3**	**-**	**-**	**1**	**-**	**1**

EC508L-Digital Signal Processing Lab

Instruction : Hours/Week : **0L:0T:2P** Credits: **1**

Sessional Marks : **40** Semester Examination Marks: **60**

Course Description:

The course is to make familiar with practical implementation of the digital signal processing. digital signal processing involving filtering, deconvolution, spectral estimation, and a variety of other techniques. Laboratory work involves developing signal processing systems on a personal computer and using them with both real and simulated data. Questions related to hardware realizations are also considered. Students can able to develop DSP algorithms for convolution, correlation, DFT, filtering of signals etc. Introduction to TMS Processors software and Hardware tools.

Course Learning Objectives:

1. Understanding the mathematical operations on discrete signals
2. Can able to design Inverse DFT and FFT of a discrete time signals.
3. Model IIR and FIR filters using different techniques.
4. Implementing different DSP algorithms on TMS processors.

Part A – Using MATLAB

1. Generation of standard signals, periodic and Aperiodic signal
2. DFT and IDFT
3. FFT algorithms - Decimation in Time / Decimation in Frequency.
4. Linear and Circular Convolution in time domain and in frequency domain (using DFT)
5. Spectrum Analysis using DFT
6. IIR filter design
7. FIR filter design
8. Decimation and Interpolation

Part B – Using Code Composer Studio

9. Linear convolution of two sequences.
10. Circular convolution of two sequences.
11. Generation of Elementary signals.
12. MAC operation using various addressing modes
13. FIR Implementation.

Learning Resources

Text Books

1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4/e, Pearson Education, 2007.
2. A.V. Oppenheim, R. W. Schafer, Discrete-Time Signal Processing, 3/e, Prentice Hall of India, 2009.

Reference Books

1. Fundamentals of Digital Signal Processing - Lonnie C Ludeman, John Wiley & Sons, 2003
2. Digital Signal Processing "A – Computer Based Approach" - Sanjit K Mitra, Tata Mc Graw Hill 2nd Edition, 2003
3. Theory and Application of Digital Signal Processing - Lawrence R Rabiner & Bernard Gold, Prentice Hall.

e- Resources & other digital material

1. http://www.nptel.iitm.ac.in/
2. http://www.ee.umanitoba.ca/~moussavi/dsp815/LectureNotes/index.html
3. http://www.ece.cmu.edu/~ee791
4. http://cobweb.ecn.purdue.edu/~ipollak/ee438/FALL04/notes/notes.html

Course Outcomes

Upon successful completion of the course, the student will be able to

1. Interpret discrete-time signals using DFT
2. Apply FFT algorithms for various signal processing operations
3. Design the Multirate Filters
4. Design IIR and FIR digital filters for real time DSP applications

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	-	-	-	-	-	-	-	1	-	-	3	-	1
CO2	3	-	-	1	-	-	-	-	-	-	-	2	1	-
CO3	3	3	-	-	-	-	-	-	-	3	-	2	-	1
CO4	3	3	3	-	2	1	-	2	-	-	-	2	-	1

EC509S-WEB Design and Development

Instruction: Hours/Week: **2L:0T:0P** **Credits: 2**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: This course offers a preliminary treatment of Web Design and Development concepts that yield visible and audible results through web pages. The course includes an introduction to the World Wide Web, industry standard browsers, effective site and page design, HTML, XHTML, CSS, XML, web graphics and client-side scripting. The course includes detailed discussion of design practices, such as the appropriate use of text and graphics, font and color selection, meta-tags, navigation techniques, media formats, and methods of enhancing the user experience.

COURSE OBJECTIVES:

1. To introduce the fundamentals of Internet, and the principles of web design.
2. To construct basic websites using HTML and Cascading Style Sheets.
3. To build dynamic web pages with validation using Java Script objects and by applying different event handling mechanisms.
4. To develop modern interactive web applications using PHP, XML and MySQL.

Unit–I

Introduction: Concept of WWW, Internet and WWW, HTTP Protocol: Request and Response, Web browser and Web servers, Features of latest version of Web.

Web Design: Concepts of effective web design, Web design issues including Browser, Bandwidth and Cache, Display resolution, Look and Feel of the Website, Page Layout and linking, User centric design, Sitemap, Planning and publishing website, Designing effective navigation.

Unit–II

HTML: Basics of HTML, formatting and fonts, commenting code, color, hyperlink, lists, tables, images, forms, XHTML, Meta tags, Character entities, frames and frame sets, Browser architecture and Web site structure. Overview and features of latest version of HTML.

Style sheets: Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2, Overview and features of latest version of CSS.

Unit–III

JavaScript: Client-side scripting with JavaScript, variables, functions, conditions, loops and repetition, Pop up boxes, Advance JavaScript: JavaScript and objects, JavaScript own objects, the DOM and web browser environments, Manipulation using DOM, forms and validations.

DHTML: Combining HTML, CSS and JavaScript, Events and buttons.

Unit–IV

XML: Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Using XML with application. Transforming XML using XSL and XSLT.

PHP: Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, Functions, Browser control and detection, string, Form processing, Files, Advance Features: Cookies and Sessions.

Unit–V

PHP and MySQL: Basic commands with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP myadmin and database bugs.

TEXT BOOKS:

1. Ralph Moseley and M. T. Savaliya, Developing Web Applications, Wiley-India Private Limited, 2011.
2. Robert W.Sebesta, Programming the World Wide Web, 7th edition, Pearson Education, 2013.

REFERENCES:

1. Kogent Learning Solutions Inc., Web Technologies Black Book, Dreamtech Press, 2009.
2. Joel Sklar, Principles of Web Design, Cengage Learning, 6th Edition, 2015.
3. B. M. Harwani, Developing Web Applications in PHP and AJAX, Tata McGraw-Hill, 2010.
4. Internet and World Wide Web How to program, Paul J. Deitel, Harvey M. Deitel, and Abbey Deitel, 5th Edition, Pearson Education, 2011.

COURSE OUTCOMES: At the end of this course, the students will be able to

1. Describe the concepts of World Wide Web, and the requirements of effective web design.
2. Develop web pages using the HTML and CSS features with different layouts as per need of applications.
3. Use the JavaScript to develop the dynamic web pages.
4. Construct simple web pages in PHP and to represent data in XML format and use server-side scripting with PHP to generate the web pages dynamically using the database connectivity.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	1	1	2	-	-	-	-	-	1	2	1	-	1
CO2	3	3	2	1	3	1	-	-	-	-	1	-	-	-
CO3	2	2	1	-	-	3	-	-	-	-	-	1	-	1
CO4	1	2	3	1	2	3	-	-	-	-	-	-	-	-

EC510A- Universal Human Values

Instruction: Hours/Week: **2L:0T:0P** **Credits: 0**

Sessional Marks: **100** End Semester Examination Marks: **0**

COURSE DESCRIPTION:
The methodology of this course is universally adaptable, involving a systematic and rational study of the human being vis-à-vis the rest of existence. It is free from any dogma or value prescriptions. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with and within the student himself/herself finally.
Pre-requisites/co-requisites: None.

COURSE OBJECTIVES:

1. To develop a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. To understand (or developing clarity) the harmony in the human being, family, society and nature/existence.
3. To strengthen self-reflection and to develop commitment and courage to act.
4. To understand social responsibility of an engineer.
5. To appreciate ethical dilemma while discharging duties in professional life.

UNIT I
Introduction - Need, Basic Guidelines, Content and Process for Value Education: Purpose and motivation for the course, Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly - A critical appraisal of the current scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

UNIT II
Understanding Harmony in The Human Being - Harmony in Myself!:
Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility(Sukh and Suvidha).Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Health.

UNIT III
Understanding Harmony in The Family and Society- Harmony in Human-Human Relationship: Understanding harmony in the Family - the basic unit of human interaction. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness(Ubhay-tripti); Trust**(Vishwas)** and Respect **(Samman)**as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution (Samadhan), Prosperity(Samridhi), fearlessness (**Abhay**) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society(AkhandSamaj), Universal Order(SarvabhaumVyawastha) - from family to world family.

UNIT IV
Understanding Harmony in The Nature and Existence - Whole Existence as Coexistence:
Understanding the harmony in the Nature. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence.

UNIT V

Implications of The Above Holistic Understanding of Harmony on Professional Ethics: Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations.

TEXT BOOKS:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.
2. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

REFERENCE BOOKS:

1. E. F. Schumancher, 1973, Small is Beautiful: a study of economics as if people mattered. Blond & Briggs, Britain.
2. N. Tripathy, 2003, Human Values, New Age International Publishers.
3. Ivan IIIich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA
4. A Nagraj, 1998 Jeevan Vidya ekParichay, Divya Path Sansthan, Amarkantak.
5. Sussan George, 1976, How the Other Half Dies, Penguin Press, Reprinted 1986, 1991.
6. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
7. E G Seebauer& Robert L.Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press.
8. M Govindrajan, S Natrajan& V. S Senthil kumar, Engineering Ethics (including Humna Values), Eastern Economy Edition, Prentice Hall of India Ltd.
9. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
10. India Wins Freedom - Maulana Abdul Kalam Azad.

Relevant CDs, Movies, Documentaries & Other Literature:

1. value Education website, http://www.uptu.ac.in
2. Story of Stuff, http://www.storyofstuff.com
3. AI Gore, An Inconvenient Truth, Paramount Classics, USA
4. Charle Chaplin, Modern Times, United Artists, USA
5. IIT Delhi, Modern Technology - the Untold Story.

COURSE OUTCOMES: On completion of this course, the students will be able to

1. To become more aware of themselves, and their surroundings (family, society, nature) and distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
2. Understand the role of a human being in ensuring harmony in society and nature.
3. To become sensitive to their commitment towards what they have understood (human values, human relationship and human society) .
4. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

ASSESSMENT:

(i). Assessment by faculty mentor: 20 marks
(ii). Socially relevant project/Group Activities/Assignments: 20 marks
(iii). Semester End Examination: 60 marks

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	1	3	-	-	-	1	1	1	-	1	1	-	-
CO2	3	-	-	1	-	3	2	-	-	-	-	-	-	-
CO3	1	-	-	-	-	3	-	-	-	-	-	-	-	-
CO4	-	2	-	-	-	1	2	3	3	1	1	2	-	-

EC601C -Microwave Engineering

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Prerequisite: Antennas and Propagation

Course Description: The course will be broadly focusing on analysis, design and development of microwave circuits and systems. The course will cover introduction to Microwaves, Microwave transmission modes, Transmission lines, Impedance Matching, Microwave Network Analysis, Directional Coupler, Power Divider, Microwave Filters, Microwave Attenuator, RF switches and phase shifters, Microwave Amplifiers, Low Noise Amplifier, Microwave Mixers and Oscillators, Microwave Antennas, Microwave Measurements, Microwave Systems.

Course Objectives:

1. To get familiarized with microwave frequency bands, their applications and to understand the limitations and losses of conventional tubes at these frequencies.
2. To distinguish between different types of microwave tubes, their structures and principles of microwave power generation.
3. To impart the knowledge of Scattering Matrix, its formulation and utility, and establish the S-Matrix for various types of microwave junctions.
4. Understand the utility of Optical Fibres in Communications.

UNIT – I

Microwave Tubes: Limitations and Losses of conventional Tubes at Microwave frequencies, Cavity Klystrons – Structure, Re-entrant Cavities, Velocity Modulation Process, Applegate Diagram, Bunching Process and Small Signal Theory – Expressions for O/P Power and Efficiency. Reflex Klystrons – Structure, Velocity Modulation and Applegate Diagram, Mathematical Theory of Bunching, Power Output, Efficiency, Oscillating Modes and O/P Characteristics. Helix TWTs: Types and Characteristics of Slow Wave Structures; Structure of TWT and Amplification Process (qualitative treatment), Suppression of Oscillations, Gain Considerations.

UNIT - II

M-Type Tubes: Introduction, Cross-field Effects, Magnetrons – Different Types, Cylindrical Traveling Wave Magnetron – Hull Cut-off and Hartree Conditions, Modes of Resonance and PI-Mode Operation, Separation of PI-Mode, o/p characteristics,

Microwave Solid State Devices: Introduction, Classification, Applications. Gunn Diodes – Principle, RWH Theory, Characteristics, Modes of Operation - Gunn Oscillation Modes, Principle of operation of IMPATT and TRAPATT Devices.

UNIT - III

Waveguide Components: Coupling Mechanisms – Probe, Loop, Aperture types. Waveguide Discontinuities – Waveguide Windows, Tuning Screws and Posts, Matched Loads. Waveguide Attenuators – Different Types, Resistive Card and Rotary Vane Attenuators; Waveguide Phase Shifters – Types, Dielectric and Rotary Vane Phase Shifters, Waveguide Multiport Junctions - E plane and H plane Tees. Ferrites– Composition and Characteristics, Faraday Rotation, Ferrite Components – Gyrator, Isolator.

UNIT – IV

Scattering matrix: Importance of S-matrix, Scattering Matrix Properties, Directional Couplers –

2 Hole, Bethe Hole S Parameters, [s] matrix of Magic Tee and Circulator, Measurement of S-parameters.
MICs : Advantages of MIC's, Hybrid MIC's, Strip lines and microstrip lines, Monolithic MICs

UNIT V

Microwave Measurements: Description of Microwave Bench – Different Blocks and their Features, Errors and Precautions, Measurement of Attenuation, Frequency. Standing Wave Measurements, Measurement of Low and High VSWR., Cavity Q-factor and Impedance Measurements. Antenna gain measurements.

TEXT BOOKS:

1. Microwave Devices and Circuits – Samuel Y. Liao, Pearson, 3rd Edition, 2003.
2. Electronic Communications Systems- Wayne Tomasi, Pearson, 5th Edition
3. Microwave Engineering - David M. Pozar, John Wiley & Sons (Asia) Pvt Ltd., 1989, 3r ed., 2011 4t. 4. Microwave Engineering - G.S. Raghuvanshi, Cengage Learning India Pvt. Ltd., 2012
5. Microwave and Radar Engineering, Kulkarni, Umesh publications, 1998.
6. Microwave Engineering, Annapurna Das and Sisir K.Das, Tata Mc Graw-Hill, 2000.

Course Outcomes: At the end of this course students will have the ability to

1. Known power generation at microwave frequencies and derive the performance characteristics. (L2)
2. Understand the principles of solid-state devices. (L1)
3. Distinguish between the different types of waveguide and ferrite components, and select proper components for engineering applications (L4)
4. Understand the utility of S-parameters in microwave component design (L3) and to know the measurement procedure of various microwave parameters. (L5)

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	2	2	1	1	1	1	2	1	2	2	3	3	-	-
CO2	3	2	2	2	1	2	2	2	2	2	3	2	1	-
CO3	3	2	2	3	1	2	2	2	1	2	3	2	-	-
CO4	3	2	3	3	2	2	2	1	2	1	3	3	-	1

EC602C-Computer Networks

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Overview:
Computer Networks plays a vital role in the era of communication systems in resources sharing applications. The aim of this course is to introduce the concepts of Computer networking and its applications.

Course Objectives:
1. To understand the basic concepts of computer networks and internet
2. To gain knowledge about the design issues of link layer and internet layer
3. To gain knowledge about the concept of connection oriented and connection less Protocols.
4. To gain knowledge in developing different applications.

Unit -1
Introduction to Computer Networks and the Internet: Principles of network applications and Internet Challenges &Layering concepts.
OSI Reference Model & TCP/IP Reference Model.

Unit -2
DATA Link layer: ALOHA, Multiple access protocols, IEEE 802 standards, Local Area Networks, Ethernet, Wireless LAN, Flow Control, Error Detection and Error Correction.

Unit-3
Internet Layer:
IP Addressing, IP Protocol, Routing Algorithms, queuing disciplines. Congestion Control Algorithms, Resource Reservation, Admission Control and Differentiated services.

Unit-4
Transport Layer: User Datagram Protocol, Connection oriented transport protocol– Transmission Control Protocol, Remote Procedure Call. Port Addressing and Socket Programming.

Unit-5.
Application layer: The Web and Hyper Text Transfer Protocol, File transfer, Electronic mail, Domain name system, Peer-to-Peer file sharing, JPEG, MPEG. Network Security: DES & RSA.

Text / Reference books:

1. J.F. Kurose and K. W. Ross, “Computer Networking – A top-down approach Pearson Education, 5th Edition
2. Andrew S Tanenbaum, “Computer Networks”, Prentice Hall India Fourth Edition.
3. Behrouz A. Forouzan, “Data Communications and Networking”, Tata McGraw Hill, 4th Edition
4. D. Comer, “Computer Networks and Internet/TCP-IP”, Prentice Hall
5. William Stallings, “Data and Computer Communication, 8th Edition, Pearson Prentice.

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Design of computer networks in Internet.
2. Understand the concepts of error handling, flow control IP Addressing and Routing.
3. Understand the concept of TCP and UDP protocols.
4. Develop several protocols foe web Applications.

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	3	3	2	2	3	2	2	2	_	3	3	--	1
CO2	1	1	1	1	1	1	3	3	2	3	1	_	-	1
CO3	1	1	1	1	1	1	3	3	2	3	1	_	-	1
CO4	3	3	3	3	2	3	2	2	3	_	3	_	-	1

EC607L- Microwave Engineering Lab

Instruction : Hours/Week : **0L:0T:2P** Credits: **1.5**

Sessional Marks : **40** Semester Examination Marks: **60**

Course Description:
Electromagnetic waves and Microwave Lab will provide practical understanding on Microwave Bench setup such as Reflex Klystron and operation of various components of the same, Gunn diode and their characteristics. This course also ensures to have practical exposure on Antenna parameters measurements and simulation of the same & optical devices and it's characteristics.

Course Objectives:

1. To understand Microwave Bench setups
2. To analyze various parameters of microwave measurements
3. To understand Antenna measurements
4. To understand the characteristics of optical fiber devices.

List of Experiments:

1. Reflex klystron characteristics – I
2. Reflex klystron characteristics – II
3. Gunn diode Oscillator
4. Waveguide parameters
5. VSWR measurements
6. Directional Couplers
7. Attenuation Measurement
8. Impedance Measurement
9. Dipole Antenna Simulation using IE3D software
10. Antenna measurements

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

1. Able to measure the performance of simple microwave circuits and devices.
2. Perform microwave measurements with sophistical instruments such as vector network analyser and spectrum analyzer.
3. Able to assess the performance of optical devices such as Light sources, fibers and detectors.
4. Able to plot the loss characteristics of optical fibers.

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	-	1	1	-	-	-	-	-	-	-	-
CO2	1	2	2	1	1		-	-	-	-	-	-	-	-
CO3	1	1	1	-	1	1	-	-	-	-	-	1	-	-
CO4	1	1	1	-	1		-	-	-	-	-	1	-	-

EC608L- COMPUTER NETWORKS LAB

Instruction: Hours/Week: **0L:0T:3P** **Credits: 1.5**

Sessional Marks: **40** End Semester Examination Marks: **60**

Prerequisites: Nil

Course Over view: This course is designed to impart knowledge about detailed knowledge of Computer Networks, various protocols used in Communication, Managing and configuring Cisco Switches and Routers, and various WAN technologies. Learn basic concepts of computer networking and acquire practical notions of protocols with the emphasis on TCP/IP.

Course Objectives: A lab provides a practical approach to Ethernet/Internet networking: Networks are assembled, and experiments are made to understand the layered architecture and how to do some important protocols work.

1. Explain network technologies and how devices access local and remote networks.
2. Explain how switching operates in a small to a medium-sized business network.
3. Design an IPv4 and IPv6 addressing scheme to provide network connectivity for a small to a medium-sized business network.
4. Implement basic network connectivity between devices.

Major Equipment Required: Required software (Open Source) like NS-2, NSG-2.1 and Wire SHARK

Note:

(a). Minimum of 12 Experiments have to be conducted

(b). All the Experiments may be Conducted using Network Simulation software like NS-2, NSG-2.1 and Wire SHARK/equivalent software.

For Experiments 2 to 10 Performance may be evaluated through simulation by using the parameters Throughput, Packet Delivery Ratio, Delay etc.

List of Experiments:

1. LAN Configuration.
2. IP Addressing.
3. Error Correction and Error Detection.
4. Routing Algorithms
5. FCFS and SJF algorithms
6. Round Robin Algorithm.
7. Peer to peer file sharing and Socket Programming

8. RSA algorithm.
9. DNS look up tables
10. HTML Design.
11. HTTP.

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

1. Understand network technologies and to access local and remote networks.
2. Operate switching in a small to a medium-sized business network.
3. Design an IPv4 and IPv6 addressing scheme to provide network connectivity for a small to a medium-sized business network.
4. Implement basic network connectivity between devices.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	2	1	1	1	-	-	-	3	-	-	2	-	1
CO2	3	2	2	2	1	2	2	2	3	-	-	2	-	1
CO3	2	2	2	2	2	-	-	-	3	-	-	2	-	1
CO4	3	2	3	3	2	-	-	-	3	-	-	1	-	-

EC609S- Internet of Things and Its Applications

Instruction: Hours/Week: 0**L:1T:2P** **Credits: 2**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Overview:

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 Learning Objectives:

The Internet is evolving to connect people to physical things and also physical things to other physical things all in real time. It's becoming the Internet of Things (IoT). The course enables student:

1. To understand the fundamentals of Internet of things and protocols.
2. It introduces some of the application areas where Internet of Things can be applied.
3. To build a small low-cost embedded system using Arduino / Raspberry Pi or equivalent boards.
4. To apply the concept of Internet of Things in the real-world scenario.

UNIT I:

Fundamentals of IoT: Introduction to IoT – Characteristics, Sensing, Actuation, Physical Design - Protocols – Logical Design – Enabling technologies – IoT Levels – Six Levels of IoT - Domain Specific IoTs.

UNIT II:

IOT and M2M: M2M, IoT vs M2M, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi, Introduction to SDN, SDN and NFV for IoT, IOT system Management with NETCONF-YANG.

UNIT III:

IoT Design Methodology: IoT Systems Management – IoT Design Methodology – Specifications Integration and Application Development. Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino.

UNIT IV:

Data Analytics for IoT: Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real-time Data Analysis.

UNIT V:

Tools for IoT: Chef, Puppet, IOT code generator Case studies: Chef. Puppet – Multi-tier Deployment, NETCONF-YANG.

IOT Applications: IoT applications for industry- Future Factory Concepts, Smart Applications, Smart Cities and Smart Homes. Case Study: Agriculture, Healthcare, Activity Monitoring. Study of existing IoT platforms /middleware, IoT- A, Hydra etc.

Text Book & References:

1. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A Hands-on Approach", Universities Press, 2015.
2. Chef, Puppet, IOT code generator Case studies: Chef. Puppet – Multi-tier Deployment, NETCONF-YANG, Raspberry Pi.
3. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012.
4. *Simon Monk, "Programming the Raspberry Pi*: *Getting Started with Python",* McGrawHill, *2013*
5. Marco Schwartz, "Internet of Things with the Arduino Yun", Pack Publishing, 2014.

Course Outcomes: Upon completion of this course, students will be able to:

1. Design a portable IoT using Arduino/ equivalent boards and relevant protocols.
2. Develop web services to access/control IoT devices.
3. Deploy an IoT application and connect to the cloud.
4. Analyze applications of IoT in real-time scenario.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	2	3	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**-**
CO2	**-**	**-**	3	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**-**
CO3	**-**	**2**	**-**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**--**	**1**
CO4	**-**	**-**	**-**	**-**	**1**	**3**	**3**	**3**	**-**	**-**	**-**	**1**		

EC610A- Professional Ethics in Engineering

Instruction: Hours/Week:**2L:0T:0P**	**Credits: 0**
Sessional Marks: **100**	End Semester Examination Marks: **0**

COURSE DESCRIPTION:

This course is designed to introduce engineering students to the concepts of engineering ethics. It will allow students to explore the relationship between ethics and engineering and apply classical moral theory and decision making to engineering issues encountered in academic and professional careers. It mainly focuses on improving the capacities of leadership /management through training in professional ethics. Codes of ethics have been invoked as a basis for professional engineering licensure. Violations of such ethical codes have led to many well-known tragic engineering failures that endangered human life and jeopardized public welfare. This discipline will doubtless take its place alongside such well-established fields as medical ethics, business ethics, and legal ethics.

Pre-requisites/co-requisites: None.

COURSE OBJECTIVES

To enable the students

1. To create an awareness on Engineering Ethics and Human Values.
2. To instill Moral and Social Values and Loyalty and to appreciate the rights of others.
3. To study the moral issues and decisions confronting individuals and organizations engaged in engineering profession.
4. To study the related issues about the moral ideals, character, policies, and relationships of people and corporations involved in technological activity.

UNIT I

Human Values: Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation –Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II

Engineering Ethics: Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy –Models of professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III

Engineering as Social Experimentation: Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT-IV

Safety, Responsibilities and Rights: Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) Discrimination.

UNIT V

Global Issues: Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct– Corporate Social Responsibility.

TEXTBOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey,2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi,2003.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd., New Delhi, 2013.

COURSE OUTCOMES: Upon completion of the course, the student should be able to:

1. Discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.
2. Learn the moral issues and problems in engineering; find the solution to those problems.
3. Learn the need for professional ethics, codes of ethics and roles, concept of safety, risk assessment.
4. Gain exposure to Environment Ethics & computer ethics; know their responsibilities and rights.

Grading/Assessment:

(i). Attendance: 20 marks

(ii). Group Activities/Assignments: 20 marks

(iii). Semester End Examination: 60 marks

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	2	**1**	**-**	**1**	**2**	**-**	**1**	**1**	**-**	**-**	**2**	**-**	**-**
CO2	**3**	**3**	2	**-**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**2**	**-**	**-**
CO3	**2**	**2**	**3**	**-**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**2**	**1**	**-**
CO4	**3**	**2**	**3**	**-**	**1**	**3**	**3**	**-**	**1**	**-**	**-**	**1**	**-**	**-**

FOURTH YEAR SYLLABUS

EC701C -Digital Image and Video Processing

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Overview:

In 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

UNIT-1:

Digital Image Fundamentals: Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures.

Image Transforms: Need for image transforms, Fourier transform, 2-D Discrete Fourier transform and its properties, Walsh Transform, Hadamard Transform, Discrete Cosine Transform.

UNIT –II

Image Enhancements and Filtering: Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain.

Sharpening filters: first and second derivative, frequency domain filters – low-pass and high-pass filters.

Image Segmentation: Detection of discontinuities, edge linking and boundary detection, thresholding –global and adaptive, region-based segmentation.

UNIT –III

Image Compression: Image compression fundamentals - Coding Redundancy, Spatial and Temporal redundancy, Compression models: Lossy & Lossless, Shannon Fano coding, Huffman coding, Bit plane coding, Transform coding, Predictive coding, Lossy Predictive coding, JPEG Standards.

UNIT –IV

Color Image Processing: Color models– RGB, YUV, HSI; Color transformations– formulation, color complements.

Video Processing: Video Formation, Perception and Representation, Video capture and display, Analog video raster, Analog color television systems, Digital video.

UNIT –V

Fundamentals of Video Coding: Inter-frame redundancy, motion estimation techniques – full search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy – Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.

Video Segmentation: Temporal segmentation–shot boundary detection, hard-cuts and soft-cuts.

Text/ Reference Books:

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008.

2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004.

3. Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2015.

4. S.Jayaraman, S.Esakkirajan and T.VeeraKumar, "Digital Image processing, Tata Mc Graw Hill publishers, 2009 .

5. Yao Wang,Jorn Ostermann and Ya Qin Zhang "Video processing and Communications" Prentice Hall Publishers, 2002, ISBN 0-13-017547-1.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Mathematically represent the various types of images and analyze them.
2. Process these images for the enhancement of certain properties or for optimized use of the resources.
3. Develop algorithms for image compression and coding.
4. Apply basic operations on video and estimate the motion of two-dimensional video.

Mapping of course outcomes with program outcomes:

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	1	2	1	-	-	-	-	3	2	-	-
CO2	3	2	3	2	2	1	-	-	-	-	3	1	-	-
CO3	2	2	2	1	1	2	-	-	-	-	3	3	2	-
CO4	2	2	2	1	1	2	-	-	-	-	3	3	2	-

EC707S-Machine learning and its Applications.

Instruction: Hours/Week: **2L:0T:0P** **Credits: 2**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description:

This course provides an introduction to the fundamental methods at the core of modern machine learning. It covers theoretical foundations as well as essential algorithms for supervised and unsupervised learning. Classes on theoretical and algorithmic aspects are complemented by practical lab sessions.

COURSE OBJECTIVES:

1. To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
2. To design and analyze various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
3. Explore supervised and unsupervised learning paradigms of machine learning.
4. To explore Deep learning technique and various feature extraction strategies.

Unit 1:

Supervised Learning (Regression/Classification) Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes. Linear models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Nonlinearity and Kernel Methods. Beyond Binary Classification: Multi-class/Structured Outputs, Ranking.

Unit 2

Unsupervised Learning -Clustering: K-means/Kernel K-means , Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion Generative Models (mixture models and latent factor models).

Unit 3

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests.)

Unit 4

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning.

Unit 5

Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference Recent trends in various learning techniques of machine learning and classification methods for IOT applications, Various models for IOT applications.

Text / References Books:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

Course Outcomes: After completion of course, students would be able to:

1. Understand the mathematical and statistical prospective of machine learning algorithms through python programming.
2. Design and evaluate the unsupervised models through python in built functions.
3. Evaluate the machine learning models pre-processed through various feature engineering algorithms by python programming.
4. Design and apply various reinforcement algorithms to solve real time complex problems.

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	1	-	-	-	-	2	1	-	2	-	1
CO2	2	1	2	-	-	-	-	-	2	1	-	2	2	-
CO3	-	2	2	-	-	-	-	-	1	1	-	2	2	-
CO4	-	-	-	2	-	-	-	-	2	1	-	2	-	-

B.Tech. (R20) EC603C --Program Elective-I	
S. No.	**Name of the Program Elective**
1.	CMOS VLSI Design
2.	Information Theory and Coding
3.	Optimization Techniques
4.	Hardware-Software Co-design

EC603C- CMOS VLSI Design

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Overview:

This is an introductory course that covers basic theories and techniques of digital VLSI design in CMOS technology. In this course, we will study the fundamental concepts and structures of designing digital VLSI systems including CMOS devices and circuits, standard CMOS fabrication processes, CMOS design rules, static and dynamic logic structures, interconnect analysis, CMOS chip layout, simulation and testing, low power techniques, design tools and methodologies, VLSI architecture.

Prerequisite Courses: Electronic Devices, Analog Circuits and Digital Logic Design

Course Learning Objectives:

1. To learn basic CMOS Circuits.
2. To learn CMOS process technology.
3. To learn techniques of chip design using programmable devices.
4. To learn the concepts of designing VLSI Subsystems.

Unit -1

Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography and twin-tub CMOS process.

Brief Introduction to MOS, PMOS, NMOS, CMOS & BiCMOS technologies. Review of MOS transistor models, Non-ideal behaviour of the MOS Transistor, $\mathbf{I_{ds} – V_{ds}}$ relationships, MOS transistor threshold Voltage, Transistor as a switch, Inverter characteristics.

Unit -2

Integrated Circuit Layout: VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for CMOS Inverters and Gates, Scaling of MOS circuits.

Basic Circuit Concepts: Sheet Resistance R_s and its concepts to MOS, Area Capacitance calculations, Inverter Delays, driving large Capacitive Loads, Wiring Capacitances. Delay: RC Delay model, linear delay model, logical path efforts. Power, interconnect and Robustness in CMOS circuit layout.

Unit -3

Combinational Circuit Design: CMOS logic families including static, dynamic and dual rail logic, Switch logic, Alternate gate circuits. Shifters, Adders, Parity generators, Comparators, Zero/One Detectors, Binary Counters, ALUs, Multipliers, Counters, High Density Memory Elements.

Unit -4

Sequential Circuit Design: Static Circuits, Design of latches and Flip-flops.

Test and Testability: Fault-modeling and simulation, test generation, design for testability, Built-in-self-test.

Unit -5

Physical Design: Floor-Planning, Placement, routing, Power delay estimation, Clock and Power routing.

Design styles: Full-custom, Standard Cells, Gate-arrays, FPGAs, CPLDs and Design Approach for Full-custom and Semi-custom devices.

Text/Reference Books:

1. Neil H.E. Weste and David Money Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4th Edition, Pearson Education India, 2015.
2. Kamran Eshraghian, Eshraghian Douglas and A. Pucknell, Essentials of VLSI circuits and systems, PHI, 2005 Edition.
3. John M. Rabaey, A. Chandrakasan, B. Nikolic, Digital Integrated Circuits: A Design Perspective", 2nd Edition, Pearson, 2016.

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

1. Learn CMOS process technology.
2. Analyze and implement various CMOS static logic circuits using Lambda based design rules.
3. Design different CMOS circuits using various logic families along with their circuit layouts for subsystem design.
4. To learn techniques of chip design using programmable devices and use HDL tools for designing VLSI Subsystems.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	**3**	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**2**	**1**	**3**	-	-	-	-	-	-	-	-	-	-	**1**
CO3	**2**	-	-	**3**	-	-	-	-	-	-	-	-	-	-
CO4	**2**	**1**	-	-	-	-	-	-	-	-	-	-	-	-

EC603C-INFORMATION THEORY AND CODING

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Overview:

Information is the source of a communication system, whether it is analog or digital. Information theory is a mathematical approach to the study of coding of information along with the quantification, storage, and communication of information. With the increasing importance in the field of digital communications, the information theory emphasizes basic aspects such as discrete modulation techniques and coding theory. The purpose of this course is to introduce various concepts in information theory, error detection and correction codes. various fundamental concepts of encoding algorithms.

Course Objectives:

The student should be made to:

1.Be familiar with the concept of amount of information, entropy, channel capacity

2.To know the different communication channels, channel capacity and relation among them.

3. To understand and analyze the various error-detection and error-correction codes

4. To know the design concepts of cyclic codes, convolution codes.

UNIT I

Information Theory: Introduction, Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences, Average Information content of symbols in Long dependent sequences, Markov Statistical Model of Information Sources, Entropy and Information rate of Markoff Sources

UNIT II:

Source Coding: Source coding theorem, Prefix Codes, Kraft McMillan Inequality property – KMI

Encoding of the Source Output, Shannon's Encoding Algorithm. Shannon Fano Encoding Algorithm, Huffman codes, Extended Huffman coding, Arithmetic Coding, Lempel – Ziv Algorithm.

UNIT III

Information Channels: Communication Channels, Channel Models, Channel Matrix, Joint probability Matrix, Binary Symmetric Channel, System Entropies, Mutual Information, Channel Capacity, Channel Capacity of: Binary Symmetric Channel, Binary Erasure Channel, Muroga,s Theorem, Continuous Channels

UNIT IV

Error Control Coding: Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes, Linear Block Codes: matrix description of Linear Block Codes, Error Detection and Error Correction Capabilities of Linear Block Codes, Single Error Correcting Hamming Codes, LDPC CODES

Binary Cyclic Codes: Algebraic Structure of Cyclic Codes, Encoding using an (n-k) Bit Shift register, Syndrome Calculation, Error Detection and Correction

UNIT V

Cyclic Codes: Golay Codes, BCH Codes.

Convolution Codes: Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, The Viterbi Algorithm, TURBO CODES .

Text Books:

1. Digital and analog communication systems, K. Sam Shanmugam, John Wiley
1. India Pvt. Ltd, 1996.
2. Digital communication, Simon Haykin, John Wiley India Pvt. Ltd, 2008.
3. Information Theory and Coding, Muralidhar Kulkarni, K.S. Shivaprakasha, WileyIndia Pvt. Ltd, 2015, ISBN:978-81-265-5305-1.

Reference Books:

1. ITC and Cryptography, Ranjan Bose, TMH, II edition, 2007
2. Principles of digital communication, J. Das, S. K. Mullick, P. K. Chatterjee, Wiley, 1986 - Technology & Engineering
3. Digital Communications – Fundamentals and Applications, Bernard Sklar, Second Edition, Pearson Education, 2016, ISBN: 9780134724058.
4. Information Theory and Coding, K.N.Haribhat, D.Ganesh Rao, CengageLearning, 2017.

Course Outcomes:

Upon completion of the course, the student should be able to:

1. Describe basic parameters of Information, the concepts of source coding techniques, and Error Control coding techniques)
2. Apply knowledge of Information theory and error control coding techniques to solve problems
3. Analyze various source coding and channel coding techniques for error detection and error correction in the information bearing signals
4. Analyze and compare audio and video coding techniques

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1	-	-	-	-	1	-	-	-
CO2	3	-	3		1	1	-	-	-	-	2	-	-	-
CO3	3	2	2	3	2	2	-	-	-	-	3	3	3	3
CO4	3	2	2	2	2	2	-	-	-	-	3	3	3	3

EC603C-Optimization Techniques

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **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.

Unit 1

Introduction to Classical Methods & Linear Programming Problems Terminology, 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.

Textbooks and 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", Addison-Wesley Longman Publishing, 1989.

Course Outcomes:

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

1. Understand importance of optimization.
2. Ability to go in research by applying optimization techniques in problems of Engineering and Technology.
3. Apply basic concepts of mathematics to formulate an optimization problem .
4. Analyze and appreciate variety of performance measures for various optimization problems .

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	-	-	-	1	-	-	-	-
CO2	3	3	2	3	2	-	-	-	-	-	-	-	2	-
CO3	1	3	3	2	1	-	-	-	-	-	1	2	1	-
CO4	-	1	2	-	-	-	-	-	-	-	-	1	1	1

EC603C-Hardware-Software Co-design

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description:

This course will cover the fundamental topics of HW/SW code design and partitioning concepts in designing embedded systems. The emphasis will be on goals and methodology for partitioning hardware/software in embedded systems**.**

Course Objectives:

1. To provide an understanding of system-level design of embedded systems comprised of both hardware and software.
2. To investigate topics such as Hardware Software partitioning, mapping and scheduling, Co-simulation, synthesis and verification relevant to co-design.
3. To explore, analysis and optimization processes in support of algorithmic and architectural design decisions.
4. Gain design experience with case studies using contemporary high-level methods and tools.

UNIT I
NATURE OF HARDWARE AND SOFTWARE

Hardware, Software, Definition of Hardware/Software Co-Design – Driving factors Platform design space – Application mapping – Dualism of Hardware design and software design – Concurrency andparallelism, Data flow modeling and Transformation – Data Flow Graph – Tokens, actors and queues,Firing rates, firing rules and Schedules – Synchronous data flow graph – control flow modeling – Adding time and resources – Transformations.

UNIT II
DATA FLOW IMPLEMENTATION IN SOFTWARE AND HARDWARE

Software Implementation of Data Flow – Converting queues and actors into software, Dynamic Scheduler – Hardware Implementation of Data Flow – single rate SDF graphs into hardware, Pipelining – Analysis of control flow and data flow – construction of control and data flow graph – Translating C into hardware – Designing data path and controller.

UNIT III
DESIGN SPACE OF CUSTOM ARCHITECTURES

Finite state machines with data path – FSMD design example, Limitations – Micro programmed Architecture – Micro programmed control, microinstruction encoding, Micro programmed data path, micro programmed machine – General purpose Embedded Core – RISC pipeline, Program organization SoC interfaces for custom hardware – Design Principles in SoC Architecture.

UNIT IV
HARDWARE/ SOFTWARE INTERFACES
Principles of Hardware/software communication – synchronization schemes, communication constrained versus Computation constrained, Tight and Loose coupling - On-chip buses – Memory mapped interfaces – coprocessor interfaces – custom instruction interfaces – Coprocessor hardware interface – Data and control design, programmer's model.

UNIT V
CASE STUDIES Trivium Cripto coprocessor – Trivium stream cipher algorithm, Trivium for 8-bit platforms – AES coprocessor, CORDIC coprocessor – algorithm and implementation.

Text Books and References:

1. Ralf Niemann, "Hardware/Software Co-Design for Data Flow Dominated Embedded Systems",
   Kluwer Academic Pub, 1998.
2. Jorgen Staunstrup, Wayne Wolf, "Hardware/Software Co-Design: Principles and Practice" , KluwerAcademic Pub, 1997.
3. Giovanni De Micheli, Rolf Ernst Morgon, "Reading in Hardware/Software Co-Design" Kaufmann Publishers, 2001.
4. Patrick Schaumont, A Practical Introduction to Hardware/Software Codesign, 2nd Edition, Springer.

Course Outcomes: After completion of this course the students will be able to

1. Analyze and apply design methodologies.
2. Appreciate the fundamental building blocks of the using hardware and software co-design and
3. Relate implementation and testing environments and techniques and their interrelationships.
4. Get familiar with modern hardware/software tools for building prototypes and to be able to
   demonstrate practical competence in these areas

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3	-	-	-	-	-	-	-	1	1	1	2
CO2	2	1	-	-	-	-	-	-	1	-	-	-	3	1
CO3	-	1	3	-	1	-	1	-	3	1	1	1	-	-
CO4	3	2	3	3	3	1	2	-	1	1	-	-	-	3

B.Tech. (R20) EC604C-Program Elective-II	
S. No.	**Name of the Program Elective**
1.	Cyber Security
2.	Nano Electronics
3.	Sensors and Transducers
4.	Electronic Instrumentation

EC604C-Cyber Security	
Instruction: Hours/Week: **3L:0T:0P**	**Credits: 3**
Sessional Marks: **40**	End Semester Examination Marks: **60**

Course Overview:

The course deals with the underlying principles of cryptography and network security. It develops the mathematical tools required to understand the topic of cryptography. Starting from the classical ciphers to modern day ciphers, the course provides an extensive coverage of the techniques and methods needed for the proper functioning of the ciphers. The course deals with the construction and cryptanalysis of block ciphers, stream ciphers and hash functions. The course defines offers the construction and cryptanalysis of public key ciphers, namely RSA. The key exchange problem and solutions using the Diffie-Hellman algorithm are discussed. Message Authentication Codes (MAC) and signature schemes are also detailed. The course deals with modern trends in asymmetric key cryptography, namely using Elliptic Curves. The course ends with the awareness about different network attacks and precautions to be taken for the security.

Course Objectives:

The student should be made to:

1. To know the basics of Cryptography and Network Security.
2. To be able to secure a message over insecure channel by various means.
3. To learn about how to maintain the Confidentiality, Integrity and Availability of a data.
4. To have the knowledge of security requirements for a network against various threats

UNIT-I

Introduction: OSI Security Architecture - Classical Encryption techniques – Cipher Principles – Data Encryption Standard – Block Cipher Design Principles and Modes of Operation - Evaluation criteria for AES – AES Cipher – Triple DES – Placement of Encryption Function – Traffic Confidentiality

UNIT-II

Public Key Cryptography Key Management - Diffie-Hellman key Exchange – Elliptic Curve Architecture and Cryptography - Introduction to Number Theory – Confidentiality using Symmetric Encryption – Public Key Cryptography and RSA.

UNIT-III

Authentication And Hash Function: Authentication requirements – Authentication functions – Message Authentication Codes – Hash Functions – Security of Hash Functions and MACs – MD5 message Digest algorithm - Secure Hash Algorithm – RIPEMD – HMAC Digital Signatures – Authentication Protocols – Digital Signature Standard.

UNIT-IV

Network Security Authentication Applications: Kerberos – X.509 Authentication Service – Electronic Mail Security – PGP – S/MIME - IP Security – Web Security.

UNIT-V

System Level Security Intrusion detection – password management – Viruses and related Threats – Virus Counter measures – Firewall Design Principles – Trusted Systems.

TextBook:

1. William Stallings, "Cryptography And Network Security – Principles and Practices", Prentice Hall of India, Third Edition, 2003.

References:

1. Atul Kahate, "Cryptography and Network Security", Tata McGraw-Hill, 2003.
2. Bruce Schneier, "Applied Cryptography", John Wiley & Sons Inc, 2001.
3. Charles B. Pfleeger, Shari Lawrence Pfleeger, "Security in Computing", Third Edition, Pearson Education.

Course Outcomes

1.Understand different encryption techniques

2. Implement basic security algorithms required by any computing system

3. Analyze the vulnerabilities in any computing system to design a security solution

4. Analyze the possible security attacks and their effective countermeasures in real time systems

Mapping of course outcomes with program outcomes:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	1	1	-	-	-	-	2	-	-	-
CO2	3	3	3	2	1	2	-	-	-	-	2	-	-	-
CO3	3	3	2	3	2	2	-	-	-	-	3	3	1	1
CO4	3	3	3	2	2	2	-	-	-	-	3	3	1	1

EC604C-Nano Electronics

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Overview:
This course covers specialized topics in modern Nano electronics. It offers an introduction to electron transport in Nano scale semiconductor devices as well as an introduction to magnetism and spintronics. Models for Nano scale transistors and quantum effects in these will be treated.

Course Objectives:
This course is aimed to:

1. Make them understand various advanced concepts in Nano electronics.
2. Explode the fundamentals on QED, SED, molecular electronics, and spintronics.
3. Train the students on state of the art computational tools for modelling and simulation of nano electronics devices.

UNIT I
Introduction: Evolution of science and nanotechnology, Introduction to nanotechnology, Difference between Nano science and nanotechnology, Feynman predictions on Nano technology, Role of up and top down approaches in nanotechnology, challenges in nanotechnology.

UNIT II
Molecular Nanotechnology: Electron microscope – scanning electron microscope – atomic force microscope –scanning tunnelling microscope – Nano manipulator – Nano tweezers – atom manipulation – Nano dots – self-assembly – dip pen nanolithography.

UNIT III
Nano powders-Synthesis and processing of Nano powders-process for producing ultrafine powders-mechanical milling, wet chemical synthesis, gas condensation process, chemical vapour condensation, laser ablation, Design and synthesis of self-assembled nanostructured materials.

UNIT–IV
Nano Materials: History of Materials, Definition, classification of Nanostructured Materials, cause of interest in Nanomaterial's, Nanomaterial's preparation-present and future applications of Nanomaterials,special nanomaterial's, characterization and tools: carbon nanotubes, Nano composites, carbon fullerenes: An overview of preparation, properties, Electron microscopy techniques: scanning Electron Microscopy, Transmission Electron Microscopy, scanning probe Microscopy-X ray Methods

UNIT-V

Nano Electronics-Introduction to micro, Nano fabrication: optical lithography, Electron beam lithography, Atomic lithography, Molecular beam Epitaxy, MEMS-Introduction, principles, Types of MEMS:-Mechanical, Thermal, Magnetic MEMS, Fabrication of MEMS.

Text /Reference Books:
1. Nano Materials by A S Edelstein& R C Cammarata, Institute of physics publishing, Bristic and Philadelphia 2. Nanotechnology by Mark Ratner & Danier Ratner, Prentice Hall. 3. Micro Manufacturing and Nano technology by N.P.Mahalik. 4. G.W. Hanson, Fundamentals of Nano electronics, Pearson, 2009. 5. W. Ranier, Nano electronics and Information Technology (Advanced Electronic Material and Novel Devices), Wiley-VCH, 2003. 6. K.E. Drexler, Nano systems, Wiley, 1992. **E-resources and other digital material** nptel.iitm.ac.in/courses.php?branch=Ece , www.cdeep.iitb.ac.in
Course outcomes Upon successful completion of the course, the student will be able to: 1. Understand various aspects of Nano-technology and the processes involved in making Nano- components and material. 2. Leverage advantages of the Nano-materials and appropriate use in solving practical problems. 3. Understand various aspects of Nano-technology and the processes involved in making Nano- components and material 4. Leverage advantages of the Nano-materials and appropriate use in solving practical problems.

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	-	-	-	1	1
CO2	1	3	3	3	2	-	-	-	-	-	2	1	1	1
CO3	1	1	3	1	3	1	1	-	1	2	-	-	1	-
CO4	1	1	1	1	1	-	-	-	-	-	-	-	1	1

EC604C-Sensors and Transducers

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Overview: It is important to understand the concepts of Sensors and Transducers. When selecting a system to use, it is important to understand the tradeoff among various components, so you can accurately use appropriate instruments. This course will cover the basic concepts of instrumentation that are important for you to understand, including the requirements for specific applications.

Course Objectives:

The purpose of the course is

1. To know the performance characteristics of instrument and the quality of measurement based on the type of transducer based on the transduction principles.
2. Understanding the concepts of Measurements and Developments in Sensor Technology.

UNIT- I

Instrument Characteristics: Block diagram of generalized instrument system, Static characteristics - Desirable & Undesirable characteristics; Dynamic characteristics - Transfer function, Dynamic response of zero order, First order and second order instruments to step input.
Measurement Errors and Statistical Analysis: Definition of parameters, Combination of limiting error, Statistical treatment, Curve fitting methods.

UNIT- II

Transducers: Classification of transducers, Characteristics of transducers.
Passive Transducer Principles: Variable resistance - Change in length and area; Variable inductance - Change in self-inductance, Change in mutual inductance, Production of eddy currents, Variable capacitance - Change in area, Distance and dielectric**.**

UNIT- III

Active Transducer Principles: Thermoelectric, Piezoelectric and Photoelectric effects
Displacement Measurement: Introduction, Pneumatic transducers - Flapper Nozzle transducer; Electrical transducers - Resistive, inductive and capacitive; Digital displacement transducer

UNIT- IV

Velocity, Acceleration and Vibration Measurement: Electromagnetic tachometer, Digital Methods - Photo electric and toothed rotor variable reluctance tachometers, Principles of accelerometers, Types of accelerometers - LVDT, Strain gauge and piezo electric accelerometers.

UNIT- V

Developments in Sensor Technology: Introduction, Smart sensors, Micro sensors, IR radiation sensors, Ultrasonic sensors, Fiber optic sensors, Chemical sensors and Bio sensors.

Text Books:

1. A.K.Ghosh, “Introduction to Measurements & Instrumentation”, 3rd Ed., PHI, 2009. (UNIT I)
2. A.K.Sawhney & Puneet Sawhney, “A Course in Mechanical Measurements & Instrumentation”, 12th Ed., Dhanapat Rai & Co., 2012. (UNIT II & III)
3. D.V.S.Murty, “Transducers & Instrumentation”, 2nd, Ed., PHI. (UNIT IV)

Reference Books:

1. Raman Pallas-Arney & John G.Webster, “Sensors & Signal Conditioning”, 2nd Ed., J. Wiley, 2012.
2. D.Patranabis, “Sensors and Transducers” 2nd Ed., PHI, 2013

E-resources and other digital material

1. http://nptel.ac.in/courses/112103174/4
2. http://nptel.ac.in/courses/112103174/3

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Analyze the various performance characteristics of instrument and the quality of Measurement.
2. Identify the type of transducer based on the transduction principles.
3. Select the relevant transducer for measurement of displacement, velocity and acceleration to meet the requirements of industrial applications.
4. Identify the additional attributes in advanced sensors.

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	1	1	-	-	-	-	-	-	-	-	-	1	-	-
CO3	1	1	1	1	1	1	1	-	-	-	-	-	-	-
CO4	1	1	1	1	1	-	-	-	-	-	-	-	-	2

EC604C- Electronic Instrumentation

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: This course deals with the basics of electronic instruments used in laboratory and industry. In the process they learn different type of instruments like voltmeter, ammeter, Q meter, Bridges, transducers and display devices CRO, CRT. After learning this subject student will be master in working principle and application of all types of instruments.

Course Objectives:

- To explain basic concepts and definitions in measurement.
- To describe the bridge configurations and their applications.
- To understand, design aspects and performance criterion of measuring instruments.
- To understand the working principle of various transducers.

UNIT-I

Measurement and Error: Definitions, accuracy and precision, types of errors.
DC Ammeters, DC Voltmeters, Series type ohmmeter, Shunt type ohmmeter. AC Voltmeter using rectifiers, True RMS responding voltmeter. Analog Instruments – Transistor voltmeter, micro voltmeter (chopper type) - DC differential voltmeter - AC voltmeters.

UNIT-II

Cathode Ray Oscilloscopes : Motion of electron in electric field and in magnetic field – Block diagram of CRO, CRT, Electrostatic deflection sensitivity – Vertical and Horizontal deflection systems – Principle of operation of Dual beam, Digital, Dual trace, Sampling and Storage CROs – Measurements with CRO (voltage, current, time, frequency, phase angle, Lissajous figures).

UNIT-III

Q meter and measurement methods.Bridges: Wheatstone, Kelvin's, Maxwell, Hay and Schering bridges. Wave analyzers (AF & RF) - Harmonic distortion analyzers – Spectrum analyzer.

UNIT-IV

Digital instruments – Digital voltmeters (Ramp, Dual slope, stair case, successive approximation types) Digital Multimeter, universal counter, Digital tachometer, Digital phase meter IEEE 488 Bus.

UNIT-V

Transducers – Classification and selection of transducers – strain gauges – Temperature measurement (resistance thermometer, thermo couples and thermistors) LVDT – Peizo electric transducer.

Text Books :

1. H.S.Kalsi, "Electronic Instrumentation" TMH, 1995.
2. Helfric and Cooper, "Modern Electronic Instrumentation and measurement techniques", PHI, 1995.
3. A.K.Sawhney , " Electrical and electronic measurements and instrumentation", Danapat Rai & Co.,18^{th} edition., 2007.

E-resources and other digital material
1.https://nptel.ac.in/courses/108106070
2.https://nptel.ac.in/courses/108106070

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Emphasize the basic electronics measurement concepts & Design the different analog and digital

   electronics voltmeters
2. Identify and use different analyzers and oscilloscopes.
3. Design the Measurement of different bridges& generators to make measurements and analyze measurement.
4. Analyze the concepts of Transducers based on applications.

Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	2	1	1	1	-	-	-	1	-	-	2	1	-
CO2	3	3	2	2	1	-	-	-	1	-	-	2	-	-
CO3	2	2	2	2	1	-	-	-	1	-	-	2	1	-
CO4	3	2	3	3	1	-	-	-	1	-	-	1	-	-

B.Tech. (R20) EC702C-Program Elective-III	
S. No	**Name of the Program Elective**
1.	Neural Networks and Fuzzy Logic
2.	Radar Systems
3.	Testing and Testability
4.	Bio-Medical Electronics

EC702C-NEURAL NETWORKS AND FUZZY LOGIC	
Instruction: Hours/Week: **3L:0T:0P**	**Credits: 3**
Sessional Marks: **40**	End Semester Examination Marks: **60**

Course Overview:

To master the various fundamental concepts of fuzzy logic and artificial neural networks.

This will help you to get sufficient knowledge to analyze and design the various intelligent control systems

Course Objectives:

1. This course introduces the basics of Neural Networks and essentials of Artificial Neural Networks with Single Layer and Multilayer Feed Forward Networks.
2. It deals with Associate Memories and introduces Fuzzy sets and Fuzzy Logic system components.
3. The Neural Network and Fuzzy Network system application to Electrical Engineering is also presented. This subject is very important and useful for doing Project Work.
4. The main objective of this course is to provide the student with the basic understanding of neural networks and fuzzy logic fundamentals.

Unit – 1

Artificial Neural Networks: Introduction to neural networks, biological neurons, artificial neurons, McCulloch-Pitt's neuron model, neuron modeling for artificial neural systems, feed forward network, perceptron network, Supervised and un-supervised learning.

Learning Rules: Hebbian learning Rule, Perceptron learning Rule, Delta learning Rule, Winner-take-all learning rule, Out-star learning rule.

Unit – 2

Supervised Learning: Perceptrons, exclusive OR problem, single layer perceptron network, multi-layer feed forward networks: linearly non separable patter classification, delta learning rule for multi perceptron layer, error back propagation algorithm, training errors , ADALINE, introduction to Radial Basis Function Networks(RBFN).

Unit – 3

Un-Supervised Learning: Hamming net, Max net. Winner–take–all learning, counter propagation network, feature mapping, self-organizing feature maps

Applications of neural Algorithms: elementary aspects of applications of character recognition.

Neural Network control applications: Process identification, Basic dynamic learning control architecture.

Unit – 4

Fundamentals of fuzzy logic and fuzzy sets: Definition of fuzzy set , a-level fuzzy set , cardinality, operations on fuzzy sets: union, intersection, complement, Cartesian product, algebraic sum, definition of fuzzy relation, properties of fuzzy relations, fuzzy composition.

Unit – 5

Design of Fuzzy Systems: Components of fuzzy systems, functions of fuzzification, Rule base patterns, Inference mechanisms.

Methods of de-fuzzification: COG, COA, MOM, Weighted average, height methods, Design of Fuzzy Systems for temperature setting of water heater, fuzzy system for control of air conditioner.

Text / References Books:

1. S.Rajasekaran & G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy logic, and Genetic Algorithms", PHI, EEE, 2003.
2. FakhreddineO.Karrry&Clarance De Silva, " Soft Computing and Intelligent Systems, Design Theory, Tools and Applications", Pearson, 2009.
3. Jacek M Zurada, " Introduction to artificial Neural Systems", Jaico Publications.
4. Zimmerman, " Fuzzy Set Theory and its Applications" , Kluwer Academic Publishers.
5. Timothy J. Ross, " Fuzzy Logic with Engineering Applications" ,(McGrawHill).

Course Outcomes:

After successful completion of the course, the student will be In a position to

1. Understand the Biological neural systems and construction of artificial neural systems.
2. Understand and explain different learning rules
3. Understand the concept of pattern classification.
4. Identify the different types of supervised and unsupervised training algorithms.

Mapping of course outcomes with program outcomes:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	1	-	-	2	-	-
CO2	3	3	2	2	1	-	-	-	1	-	-	2	-	-
CO3	2	2	2	2	1	-	-	-	1	-	-	2	-	-
CO4	3	2	3	3	1	-	-	-	1	-	-	1	-	-

EC702C-RADAR ENGINEERING

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Overview:

It is important to understand the concepts of principles of Radar Engineering, Mri radar and practical applications of Radar.

Course Objectives: The purpose of the course is

1. To understand the basic principle of radar systems and Doppler and MTI Radar.
2. To know how the detection of Noise and principle of Radar receiver.

UNIT I

INTRODUCTION TO RADAR: Basic Radar, The simple form of the Radar Equation, Radar Block Diagram and operation, Applications of Radar, The Radar Equation, Detection of Signals in Noise, Receiver Noise and the Signal to-Noise Ratio, Probability Density Functions-Probabilities of Detection and False Alarm-Integration of Radar Pulses, Radar Cross Section of Targets Radar cross Section Fluctuations- Transmitter Power, Pulse Repetition Frequency-System losses.

UNIT-II

MTI Radar: Introduction to Doppler and MTI Radar- Delay Line Cancellers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance.

UNIT- III

Pulse Doppler Radar: Tracking with Radar, Mono-pulse Tracking, Conical Scan and Sequential Lobing, Limitations to Tracking Accuracy, Low-Angle Tracking: Tracking in Range, Other Tracking Radar Topics, Comparison of Trackers, Automatic Tracking with Surveillance Radars (ADT), Radar Antennas.

UNIT- IV

Detection of Signals in Noise: Introduction, Matched Filter Receiver, Detection Criteria, Detectors, Automatic Detector, Integrators, Constant-False Alarm Rate Receivers, The Radar operator, Signal Management

UNIT- V

The Radar Receiver: Receiver noise Figure, Super heterodyne Receiver, Radar Displays. Applications: Electronic Support Measure (ESM), Electronic Counter Measure (ECM), Electronic Counter-Counter Measure (ECCM), Stealth Technology.

Text Books:

1. Merrill I Skolnik, Introduction to Radar Systems, 3rd edition, TMH, 2003.
2. Principles of Modern radar system, M. H. Carpentier, Artech House,1998.
3. Radar Technology, Brookner, Eli, Artech House

4. Peyton Z Peebles Jr. (2004), "Radar Principles", John Wiley Inc.,
5. Bahman Zohuri, 'Radar Energy Warfare and the Challenges of Stealth Technology", Springer.

E-resources and other digital material

1. https://ocw.mit.edu/resources/res-ll-003-build-a-small-radar-systemcapable-of-sensing-range- doppler-and-synthetic-aperture-radar-imagingjanuary-iap-2011/lecture-notes/

2. http://www.radartutorial.eu/07.waves/wa04.en.html

Course outcomes

Upon successful completion of the course, the student will be able to:

1. Understand the principles and applications of RADAR
2. Demonstrate the Doppler Effect and the concepts of continuous wave radars.
3. Analyze the tracking radar systems and mono pulse radar.
4. Understand radar signal detection in presence of noise and its performance

Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	-	-	-	-	-	-	1	1
CO2	1	1	1	2	-	-	-	-	-	-	-	-	2	3
CO3	2	2	2	2	-	-	-	-	-	-	-	-	2	3
CO4	3	2	3	3	1	-	-	-	1	-	-	-	-	-

EC702C-Testing and Testability

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Pre-requisite, if any: **Digital Logic Design**

Course Overview: The purpose of the course is know the to understand the VLSI testing, types of faults and Fault Diagnosis.

Course Objectives: The purpose of the course is

1. To learn the role of VLSI testing.
2. Understand the types of Faults, Design for Testability and Fault Diagnosis.

Unit-1

Role of testing in VLSI Design flow, Testing at different levels of abstraction, Fault error, defect, diagnosis, yield, Types of testing, Rule of Ten, Defects in VLSI chip. Modelling basic concepts, Functional modelling at logic level and register level, structure models, logic simulation, delay models.

Unit-2

Various types of faults, Fault equivalence and Fault dominance in combinational sequential circuits. Fault simulation applications, General fault simulation algorithms- Serial, and parallel, Deductive fault simulation algorithms. Combinational circuit test generation, Structural Vs Functional test, ATPG, Path sensitization methods.

Unit-3

Difference between combinational and sequential circuit testing, five and eight valued algebra, and Scan chain-based testing method. D-algorithm procedure, Problems, PODEM Algorithm, Problems on PODEM Algorithm. FAN Algorithm, Problems on FAN algorithm, Comparison of D, FAN and PODEM Algorithms. Design for Testability, Ad-hoc design, Generic scan-based design.

Unit-4

Classical scan-based design, System level DFT approaches, Test pattern generation for BIST, and Circular BIST, BIST Architectures, and Testable memory design-Test Algorithms -Test generation for Embedded RAMs.

Unit-5

Fault Diagnosis Logic Level Diagnosis - Diagnosis by UUT reduction - Fault Diagnosis for Combinational Circuits - Self-checking design - System Level Diagnosis.

Text Book(s):

1. M. Abramovici, M. Breuer, and A. Friedman, “Digital Systems Testing and Testable Design, IEEE Press, 1990.
2. Stroud, “A Designer’s Guide to Built-in Self-Test”, Kluwer Academic Publishers, 2002.

References & Web Resources:

3. M. Bushnell and V. Agrawal, “Essentials of Electronic Testing for Digital, Memory & Mixed-Signal VLSI Circuits”, Kluwer Academic Publishers, 2000
4. V. Agrawal and S.C. Seth, Test Generation for VLSI Chips, Computer Society Press.1989.
5. M. Abramovici, M.A. Breuer and A.D. Friedman, "Digital Systems and Testable Design", Jaico Publishing House.
6. M.L. Bushnell and V.D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers.
7. P.K. Lala, "Digital Circuit Testing and Testability", Academic Press, 2002.
8. A.L. Crouch, "Design Test for Digital IC's and Embedded Core Systems", Prentice Hall International.

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

1. Identify the significance of testable design
2. Understand the concept of yield and identify the parameters influencing the same
3. Specify fabrication defects, errors and faults.
4. Implement combinational and sequential circuit test generation algorithms and techniques to improve fault coverage

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	1	-	-	2	1	1
CO2	3	3	2	2	1	-	-	-	1	-	-	2	-	-
CO3	2	2	2	2	1	-	-	-	1	-	-	2	-	-
CO4	3	2	3	3	1	-	-	-	1	-	-	1	1	1

EC702C-Bio-Medical Instrumentation

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Overview: The purpose of the course is know the human physiology and various sources of

bioelectric signals and the types of electrodes to be used and Safety aspects to be followed.

Course Objectives: The purpose of the course is

1. To gain knowledge on human physiology for measurement of electrical and non-electrical parameter in the human body.
2. Understand medical assisting and therapy equipment and safety measures when using Bio-Medical Instrumentation.

Unit-1

Brief introduction to human physiology- Problems encountered while making measurements on a human body-Structure of cell – Function of each components of the cell – Membrane potential – Action potential – Generation and Conduction- Anatomy and Physiological aspects of respiration.

Unit-2

Bio-electrodes and bio-potential amplifiers ---Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half cell potential, impedance, polarization effects of electrode – non-polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems .

Unit-3

. Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier, isolation amplifiers, Chopper amplifier. ECG, EEG, EMG Lead systems and recording methods, Typical waveforms.

Unit-4

Measurement of blood temperature, pressure and flow. Impedance plethysmography. Ultrasonic, X-ray and nuclear imaging.

Prostheses and aids: Introduction to Pacemakers, defibrillators, heart-lung machine, Dialyzers, Diathermy .

Unit-5

Safety aspects: – devices to protect against electrical hazards – Ground fault interrupter, isolation transformer, line isolation monitor, receptacle tester, electrical safety analyzer equipment, preventive maintenance.

Text Book:

1. Leslie Cromwell, Fred. J, Weibell and Erich A. Pleiffer, “Biomedical Instrumentation and Measurements”, 2nd Ed., Prentice Hall of India, 2004
2. R.S.Kandpur. “Handbook of Biomedical Instrumentation”, 2nd Ed., TataMcGraw Hill, 2011
3. Webster, “Medical Instrumentation Application & Design”, John Wiley & Sons

E-resources and other digital material:

1. http://www.eeeuniversity.com/2013/08/ei2311-biomedical-instrumentation.html

Course outcomes: Upon successful completion of the course, the student will be able to:

1. Understand the physical foundations of biological systems and bioelectric potentials in medical field and Examine the various sources of bioelectric signals and the types of electrodesto be used.
2. Describe the acquisition and amplification of the bio-signals
3. Gain knowledge on the measurement of electrical and non-electrical parameter in the human body and Understand medical assisting and therapy equipment.
4. Discuss on electrical safety, hazards, protection against shock and testing of electrical systems

Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	2	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	2	-	-
CO3	2	2	2	2	-	-	-	-	-	-	-	2	-	-
CO4	3	2	3	3	1	-	-	-	1	-	-	1	-	-

B.Tech. (R20) EC703C-Program Elective-IV	
S.No	**Name of the Program Elective**
1.	Satellite Communication
2.	Fiber Optic Communications
3.	Wireless Communications
4.	MEMS

EC703C-Satellite Communication

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Overview:

This course will provide you with an in-depth background of satellite communication techniques, modern satellite multiple access, modulation and coding schemes, as well as providing an update on key emerging technologies and future systems.

Course Objectives:

1. To Enable students to become familiar with satellites and satellite services.
2. Study of satellite orbits and launching.
3. Study of Earth segment and space segment components.
4. Study of satellite access by various users.

Unit -1

Introduction to Satellite Communication: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication.

Orbital Mechanics: Orbital equations, Kepler's laws, 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 -2

Satellite sub-systems: Study of 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 etc.

Unit -3

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. Satellite link budget.

Unit -4

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.

Unit -5

Modulation and Multiple Access Schemes: Various modulation schemes used in satellite communication, Meaning of Multiple Access, Multiple access schemes based on time, frequency, and code sharing namely TDMA, FDMA and CDMA.

Text /Reference Books:

1. Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications: Wiley India. 2nd edition 2002.
2. Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill, 2009.
3. Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill, 2009.

Course Outcomes: At the end of this course students will demonstrate the ability 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.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1	PO1	PS01	PS02
CO1	3	3	2	1	1	-	-	-	-	-	1	1	-	1
CO2	2	3	1	2	1	-	-	-	-	-	-	-	-	1
CO3	1	1	3	3	1	-	-	-	-	-	1	-	-	1

-

EC703C-Fiber Optic Communications

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Overview:

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.

Unit -1

Overview of Optical Fiber Communication: The evolution of fiber optic systems, elements of an optical fiber transmission link, block diagram, advantages of optical fiber communication, applications.

Introduction to vector nature of light, propagation of light, Ray theory transmission, total internal reflection, acceptance angle, numerical aperture and skew rays, propagation of light in a cylindrical dielectric rod, Ray model, wave model., Modes, electromagnetic mode theory and propagation, single mode and multimode fibers, linearly polarized modes.

Unit -2

Different types of optical fibers, Fiber material, fiber cables and fiber fabrication, fiber joints, fiber connectors, splicer, Modal analysis of a step index fiber. Signal degradation on optical fiber due to dispersion and attenuation, Fabrication of fibers and measurement techniques like OTDR.

Unit -3

Optical Sources and Detectors: Coherent and non-coherent sources, quantum efficiency, modulation capability of optical sources, LEDs: Working principle and characteristics, Laser diodes: Working principle and characteristics, Working principle and characteristics of Photo-detectors: PIN-diodes, APDs, detector responsivity, noise analysis in detectors, coherent and non-coherent detection

Unit -4

Optical Receiver, Switches & Amplifiers

Receiver structure, bit error rate of optical receivers, and receiver performance, Optical link design - BER calculation, quantum limit, power penalties.
Optical switches - coupled mode analysis of directional couplers, electro-optic switches.
Optical amplifiers - EDFA, Raman amplifier.

Unit -5

Optical Networks: SONET and SDH standards, architecture of optical transport networks (OTNs), network topologies, Operational principle of WDM and DWDM systems, WDM network elements and Architectures, Principles of WDM networks, Solutions.
Nonlinear effects in fiber optic links: Concept of self-phase modulation, group velocity dispersion and solution based communication.

Text/Reference Books:

1. J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
2. John M. Senior, Optical Fiber Communications: Principles and Practice, Pearson, 3rd Ed. 2008.

   G. Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the principles fiber-optic communication, the components and the bandwidth advantages.
2. Understand the properties of the optical fibers and optical components.
3. Understand operation of lasers, LEDs, and detectors.
4. Analyze system performance of optical communication systems and design optical networks and understand non-linear effects in optical fibers.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	2	-	-	-	-	-	-	-	-	-	-	1		1
CO2	2	2	-	-	-	-	-	-	-	-	-	1	1	
CO3	2	1	3									2	1	
CO4	-	-	-	-	2	2	-	2	-	1	2	-		

EC703C-WIRELESS COMMUNICATION

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **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 the fundamental treatment about many practical and theoretical concepts that forms Basic of wireless communications.
2. To equip the students with various kinds of wireless networks and it's operations .
3. To provide an to provide analytical perspective on the design and analysis of traditional and emerging wireless networks, And to discuss the need to get off and solution methods, the fundamental problems in wireless networking .
4. To train students do understand the architecture and operation of various wireless wide area networks such as GSM, IS-95, GPRS and SMS.
5. To train students to understand wireless LAN architectures and operations.
6. To prepare students to understand the emerging techniques OFDM and its importance in the wireless communications.

UNIT-I

THE CELLULAR CONCEPT-SYSTEM DESIGN FUNDAMENTALS: Introduction, Frequency reuse, Channel assignment strategies, Handoffs strategies-prioritizing handoffs, Practical handoff considerations, Interference and system capacity – Co-channel interference and system capacity, Channel planning for wireless systems, Adjacent channel interference, Power control for reducing interference, Trunking and grade of service, Improving coverage and capacity in cellular systems - Cell splitting, Sectoring.

UNIT-II

MOBILE RADIO PROPAGATION LARGE-SCALE PATH LOSS: Introduction to radio wave propagation, Free space propagation model, Relating power to electric field, The three basic propagation mechanisms, Reflection-reflection from dielectrics, Brewster angle, Reflection from prefect conductors, Ground reflection (two-ray) model, Diffraction-fresnel zone geometry, Knife-edge diffraction model, Multiple knife-edge diffraction, Scattering, Outdoor propagation models-Longley-Ryce model, Okumura model, Hata model, PCS extension to Hata model, Walfisch and Bertoni losses (Same floor), Partition losses between floors, Log-distance path loss model, Ericsson multiple breakpoint model, Attenuation factor model, Signal penetration into buildings, Ray tracing and site specific modeling.

UNIT-III

MOBILE RADIO PROPAGATION: SMALL-SCALE FADING AND MULTIPATH: Small scale multipath propagation-factors influencing small scale fading, Doppler shift, Impulse response model of a multipath channel-Relationship between Bandwidth and received power, small-scale multipath measurements Direct RF pulse system, Spread spectrum sliding correlator channel sounding, Frequency domain channels sounding, Parameters of mobile multipath channels-time dispersion parameters, Coherence bandwidth, Doppler spread and coherence time, Types of small-scale fading-fading effects, Due to multipath time delay spread, flat fading, Frequency selective fading, Fading effects due to Doppler spread-fast fading, Slow fading, Statistical models for multipath fading channels-clarke's model for flat fading, Spectral shape due to Doppler spread in Clarke's model, Simulation of Clarke and gans fading model, Level crossing and fading st statistics, Two-ray Rayleigh fading model.

UNIT-IV

EQUALIZATION AND DIVERSITY: Introduction, Fundamentals of equalization, Training a generic adaptive equalizer, Equalizers in a communication receiver, Linear equalizers, Non-linear equalization Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer, Algorithms for adaptive equalization-zero forcing algorithm, Least means square algorithm, Recurisve least squares algorithm, Diversity techniques-derivation of selection diversity improvement, Derivation of maximal ratio combining improvement, Practical space diversity consideration-selection diversity, Feedback or scanning diversity, Maximal ratio combining, Equal gain combining, Polarization diversity, Frequency diversity, Time diversity, RAKE receiver.

UNIT-V

WIRELESS NETWORKS: Introduction to wireless networks, Advantages and disadvantages of wireless local area networks, WLAN topologies, WLAN standard IEEE 802.11, IEEE 802.11 medium access control, Comparision of IEEE 802.11 a, b, g and n standards, IEEE 802.16 and its enhancements, Wireless PANs, HiperLan, WLL.

TEXT BOOKS:

1. Rappaport,T.S., ―Wireless communications‖, Pearson Education, Second Edition, 2010.(UNIT I, II, IV)
2. Andreas.F. Molisch, ―Wireless Communications‖, John Wiley – India, 2006.(UNIT III,V)

REFERENCES:

1. Wireless Communication –Andrea Goldsmith, Cambridge University Press, 2011
2. Van Nee, R. and Ramji Prasad, ―OFDM for wireless multimedia communications, Artech House, 2000
3. David Tse and Pramod Viswanath, ―Fundamentals of Wireless Communication, Cambridge University Press, 2005.
4. Upena Dalal, ―Wireless Communication‖, Oxford University Press, 2009.

Course Outcomes:

Upon completion of the course, the student will be able to:

1. Understand the principles of wireless communications.
2. Understand fundamentals of wireless networking.
3. Understand cellular system design concepts.
4. Analyse various multiple access schemes used in wireless communication.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	2	-	-	-	-	-	-	-	-	-	-	1	-	1
CO2	2	-	-	2	-	-	-	-	-	-	-	1	-	1
CO3	-	1	2	-	-	2	-	-	-	-	2	-	-	
CO4	1	2	1	1	-	-	-	-	-	-	1	2	-	1

EC703C-MEMS

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Overview:

The course will cover fabrication technologies, material properties, structural mechanics, basic sensing and actuation principles, packaging, and MEMS markets and applications. The course will emphasize the fabrication and materials of micro/nano systems.

Course Objectives:

1. Key aim is to learn micro-electro-mechanical systems (MEMS) and micro-integrated system.
2. Properties of useful materials will be discussed in context to MEMS and BioMEMS. Micro-electronics process modules used in the design and fabrication of MEMS and micro-integrated systems will be presented.
3. Applications of these systems in a variety of sensors and transducers for broad ranges of implantable biomedical applications will be described.
4. Recent advances in wearable biomedical applications of MEMS and bio MEMS will also be discussed in detail.

Unit -1
Introduction and Historical Background, Scaling Effects, Micro/Nano Sensors.

Unit -2
Actuators and Systems overview: Case studies.

Unit -3
Review of Basic MEMS fabrication modules: Oxidation, Deposition Techniques, Lithography (LIGA), and Etching.

Unit -4
Micromachining: Surface Micromachining, sacrificial layer processes, Stiction, Bulk Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding.

Unit -5

Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending; Energy methods, Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

Text/Reference Books:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.

2. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and
3. Microengineering (Vol. 8). CRC press, (2005).
4. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
5. M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.
6. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
7. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Appreciate the underlying working principles of MEMS and NEMS devices.
2. Design and model MEM devices.
3. Gain a knowledge of basic approaches for various sensor design
4. Gain the technical knowledge required for computer-aided design, fabrication, analysis and characterization of Nano-structured materials, micro- and Nano-scale devices.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	2	1	3	2	2	1	-	-	-	-	1	1	-	-
CO2	1	-	3	3	1	1	1	-	-	-	-	-	1	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	1	-
CO4	2	3	2	1	-	-	-	-	-	1	1	-	-	-

B.Tech. (R20) **EC704C-Program Elective-V**	
S.No	**Name of the Program Elective**
1.	Embedded System Design
2.	Real Time Operating System
3.	FPGA Based System Design
4.	Digital Signal Processors & Architectures

EC704C-Embedded System Design

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description:

This course is **to enable the students to understand embedded-system programming and apply that knowledge to design and develop embedded solutions**. Interaction with peripheral devices. Activities. Identify hardware and software components to build an embedded system.

Prerequisite: Microprocessors and Microcontrollers; Computer Organization and Operating Systems.

Course Objectives:

1. To provide an overview of Design Principles of Embedded System.
2. To provide clear understanding about the role of firmware.
3. To understand the necessity of operating systems in correlation with hardware systems.
4. To learn the methods of interfacing and synchronization for tasking.

UNIT - I:

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

UNIT - II:

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

UNIT - III:

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

UNIT - IV:

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

UNIT - V:

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, Methods to Choose an RTOS.

TEXT BOOKS:

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

REFERENCE BOOKS:

1. Embedded Systems - Raj Kamal, TMH.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
3. Embedded Systems – Lyla, Pearson, 2013
4. An Embedded Software Primer - David E. Simon, Pearson Education.
5.

Course Objectives:

1. To provide an overview of Design Principles of Embedded System.
2. To provide clear understanding about the role of firmware.
3. To understand the necessity of operating systems in correlation with hardware systems.
4. To learn the methods of interfacing and synchronization for tasking.

Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	**3**	1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	1	-	1	1	-	**-**	**-**	**-**	**1**	**-**	**-**	1	-	-
CO3	2	2	2	1	-	**-**	**-**	**-**	**1**	**-**	**-**	**2**	-	-
CO4	3	2	1	-	-	**-**	**-**	**-**	**1**	**-**	**-**	**1**	-	-

EC704C-Real Time Operating System

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Abstract / Outline:

In several software applications, especially in embedded application, the operating system is required to support the application to meet the timing constraints. The operating system achieves this by deploying suitable scheduling algorithms. A major problem arises, when the real-time tasks share resources. Priority inversions can take place in this case, unless suitable techniques are deployed. Starting with a brief introduction to real-time operating systems, we first discuss the important real-time task/thread scheduling algorithms and resource sharing protocols. An effort towards standardization of real-time operating systems has come to be known as POSIX-RT. We review POSIX-RT requirements. Besides, we review several commercial and open source real-time operating systems.

Prerequisites: C Programming, Computer Organization and Operating Systems, and Operating Systems.

Course Objectives:

1. To provide an overview of Design Principles of Embedded System.
2. To provide clear understanding about the role of firmware.
3. To understand the necessity of operating systems in correlation with hardware system.
4. To learn the methods of interfacing and synchronization for tasking.

UNIT – I:

Introduction: Introduction to UNIX/LINUX, Overview of Commands, File I/O, (open, create, close, lseek, read, write), Process Control (fork, vfork, exit, wait, waitpid, exec).

UNIT – II:

Real Time Operating Systems: Brief History of OS, Defining RTOS, The Scheduler, Objects, Services, Characteristics of RTOS, defining a Task, asks States and Scheduling, Task Operations, Structure, Synchronization, Communication and Concurrency. Defining Semaphores, Operations and Use, Defining Message Queue, States, Content, Storage, Operations and Use.

UNIT – III:

Objects, Services and I/O: Pipes, Event Registers, Signals, Other Building Blocks, Component Configuration, Basic I/O Concepts, I/O Subsystem.

UNIT – IV:

Exceptions, Interrupts and Timers: Exceptions, Interrupts, Applications, Processing of Exceptions and Spurious Interrupts, Real Time Clocks, Programmable Timers, Timer Interrupt Service Routines (ISR), Soft Timers, Operations.

UNIT – V:

Case Studies of RTOS: RT Linux, Micro C/OS-II, Vx Works, Embedded Linux, and Tiny OS.

TEXT BOOK:

1. Qing Li, "Real Time Concepts for Embedded Systems", 2011, Elsevier.

REFERENCE BOOKS:

1. Rajkamal, "Embedded Systems- Architecture, Programming, and Design", 2007, TMH.
2. W. Richard Stevens, Stephan A. Rago, "Advanced UNIX Programming", 2006, 2nd Edition, Pearson.
3. Dr. Craig Hollabaugh, "Embedded Linux: Hardware, Software and Interfacing", 2008, 1st Edition, Pearson.

Course Outcomes:

1. Understand concepts of Real-Time systems and modeling
2. Recognize the characteristics of a real-time system
3. Understand and develop document on an architectural design of a real-time system
4. Develop and document Task scheduling, resource management, real-time operating systems and fault tolerant applications of Real-Time Systems.

Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	**3**	1	2	1	-	-	-	-	-	-	1	1	-	1
CO2	2	**1**	1	1	-	-	-	-	-	-	-	-	-	-
CO3	2	3	**3**	2	1	-	-	-	-	-	-	-	-	**1**
CO4	1	3	**3**	1	1	-	-	-	**1**	-	1	**1**	-	-

EC704C-FPGA Based System Design

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Pre-Requisite(s): Digital Logic Design

Course Description: This course covers the advanced design and analysis of digital circuits with HDL. The primary goal is to provide in depth understanding of system design. The course enables students to apply their knowledge for the design of advanced digital hardware systems with help of FPGA tools.

Course Objectives:

1. Understand Digital system design using HDL.
2. Know FPGA architecture, interconnect and technologies.
3. Know different FPGA's and implementation methodologies.
4. Understand configuring and implementing digital embedded system, micro-controllers, microprocessors, DSP algorithms on FPGA.

UNIT I:

Verilog HDL Coding Style: Lexical Conventions - Ports and Modules – Operators - Gate Level Modeling - System Tasks &Compiler Directives - Test Bench - Data Flow Modeling - Behavioral level Modeling -Tasks & Functions.

UNIT II:

Overview of FPGA Architectures and Technologies: FPGA Architectural options, coarse vs fine grained, vendor specific issues (emphasis on Xilinx FPGA), Antifuse, SRAM and EPROM based FPGAs, FPGA logic cells, interconnection network and I/O Pad.

UNIT III:

Verilog Modelling of Combinational and Sequential Circuits: Behavioral, Data Flow and Structural Realization – Adders – Multipliers- Comparators - Flip Flops - Realization of Shift Register - Realization of a Counter- Synchronous and Asynchronous FIFO –Single port and Dual port RAM – Pseudo Random LFSR – Cyclic Redundancy Check.

UNIT IV

Synchronous Sequential Circuits: State diagram-state table –state assignment-choice of flipflops – Timing diagram –One hot encoding Mealy and Moore state machines – Design of serial adder using

Mealy and Moore state machines - State minimization – Sequence detection- Design examples: Sequence detector, Serial adder, Vending machine using One Hot Controller. Optimization of Speed: Introduction, Strategies for Timing Improvement; Optimization of Area, Optimization of power.

Unit V

FPGA and its Architecture: Types of Programmable Logic Devices- PLA & PAL- FPGA Generic Architecture. Types of FPGAs, CLBs vs LAB vs Slices, MUX vs LUT based logic implementation, ALTERA Cyclone II Architecture – Timing Analysis and Power analysis using Quartus-II- SOPC Builder- NIOS-II Soft-core Processor- System Design Examples using ALTERA FPGAs – Traffic light Controller, Real Time Clock -Interfacing using FPGA: VGA, Keyboard, LCD.

Text Books:

1. M.J.S. Smith, "Application Specific Integrated Circuits", Pearson, 2000.
2. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis" Prentice Hall, Second Edition, 2003, ISBN: 0130449113.
3. Wayne Wolf, "FPGA Based System Design", with CD-ROM, 2004, Prentice Hall, ISBN: 0131424610.
4. S. Ramachandran, "Digital VLSI System Design: A Design Manual for implementation of Projects on FPGAs and ASICs Using Verilog" Springer Publication, 2007.
5. Stephen Brown & ZvonkoVranesic, "Digital Logic Design with Verilog HDL" TATA McGraw Hill Ltd. 2nd Edition 2007.

References:

1. Pong P. Chu, "FPGA Prototyping by Verilog Examples: Xilinx Spartan-3," Wiley-Interscience, 1st Edition, 2008, ISBN-10: 0470185325.
2. Steven Kilts, "Advanced FPGA Design: Architecture, Implementation and Optimization" Wiley-IEEE Press, 1st Edition, 2007, ISBN:0470054379
3. Peter Ashenden, "Digital Design using Verilog", Elsevier, 2007.
4. Michael D. Ciletti, "Advanced Digital Design with the Verilog HDL," First Edition, 2003, Prentice Hall, ISBN: 0130891614.

Course Outcomes: Upon successful completion of this course, students will be able to:

1. Design and optimize complex combinational and sequential digital circuits by using Verilog HDL.
2. Design and model digital circuits with Verilog HDL at behavioural, structural, and RTL Levels.
3. Develop test benches to simulate combinational and sequential circuits and analyse Digital design in terms of area, power and speed..
4. Understand the FPGA Architecture and Implementation of the combinational and sequential digital circuits in FPGA.

Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	1	-	-	2	-	-
CO3	-	-	3	-	-	-	-	-	1	-	-	2	-	-
CO4	-	-	3	-	-	-	-	-	1	-	-	1	-	-

EC704C-Digital Signal Processors & Architectures

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **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.

Prerequisite: Students should have an understanding of Microcontroller architecture as well as basic C and assembly language programming skills and basic understanding of discrete time signals and systems

Course Objectives:

1. To describe features and architectural improvements of DSP processors.
2. To introduce addressing modes and instruction description of TMS320C6x processors.
3. To demonstrate data representation in DSP Processors and FIR filters.
4. 4. To demonstrate the usefulness of the adaptive filters and learn techniques of code optimization.

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.

Textbooks and 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.

Course Outcomes:

At the end of this course students will be able to

1. Identify and formalize architectural level characterization of P-DSP hardware
2. Ability to design, programming (assembly and C), and testing code using Code Composer Studio environment
3. Deployment of DSP hardware for Control, Audio and Video Signal processing applications
4. Understanding of major areas and challenges in DSP based embedded systems

Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	2	2	1	-	-	-	-	-	-	-	-	1	-
CO2	1	3	3	3	-	-	-	-	1	-	-	-	-	-
CO3	1	3	3	3	2	1	-	-	1	-	-	-	1	-
CO4	1	1	1	1	-	-	-	-	1	-	-	1	-	-

SYLLABUS

FOR

Honors Degree, Minors in Electronics

and Minors in Communications

Courses offered for Honors degree

ECHN01- Advanced Digital Signal Processing

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: Digital signal processing is a method of processing real world signals (represented by a sequence of numbers) using mathematical techniques to perform transformations or extract information.

Course Objectives:

1. To analyze multirate DSP systems.
2. To determine coefficients for perfect reproduction filter banks and wavelets.
3. To choose parameters to take a wavelet transform, and interpret and process the result.

UNIT-I

Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in sub band coding

UNIT-II

Linear prediction & optimum linear filters, stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.

UNIT-III

Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm

UNIT-IV

Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum-Variance Spectral Estimation, Eigenanalysis Algorithms for Spectrum Estimation.

UNIT-V

Application of DSP & Multi rate DSP, Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications.

Text Books :

1.J.G.Proakis and D.G.Manolakis"Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007.
2.N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets", 1st Edition, John Wiley and Sons Ltd, 1999.
3.Bruce W. Suter, "Multirate and Wavelet Signal Processing",1st Edition, Academic Press, 1997.
4.M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc., 2002.
5.S.Haykin, "Adaptive Filter Theory", 4th Edition, Prentice Hall, 2001.
6.D.G.Manolakis, V.K. Ingle and S.M.Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. To understand theory of different filters and algorithms
2. To understand theory of multi rate DSP, solve numerical problems and write algorithms
3. To understand theory of prediction and solution of normal equations
4. To know applications of DSP at block level

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1					1			
CO2	3		3		1	1					2			
CO3	3	2	2	3	2	2					3	3	3	3
CO4	3	2	2	2	2	2					3	3	3	3

ECHN02- Antennas and Radiating Systems

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: Radiation intensity, or the antenna power pattern, in a given direction is defined as the power radiated from an antenna per unit solid angle. The radiation intensity is a far field parameter which can be obtained by simply multiplying the radiation power density by the square distance

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.

UNIT-I

Types of Antennas: Wire antennas, Aperture antennas, Micro strip antennas, Array antennas 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-II

Linear Wire Antennas: Infinitesimal dipole, Small dipole, Region separation, Finite length dipole, half wave dipole, Ground effects.

Loop Antennas: Small Circular loop, Circular Loop of constant current, Circular loop with non uniform current.

UNIT-III

LinearArrays: Two element array, N Element array: Uniform Amplitude and spacing, Broadside and End fire array, Super directivity, Planar array, Design consideration.

UNIT-IV

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-V

Micro strip Antennas: Basic Characteristics, Feeding mechanisms, Method of analysis, Rectangular Patch, Circular Patch, Reflector Antennas: Plane reflector, parabolic reflector, Cassegrain reflectors, Introduction to MIMO.

Text Books :

1. Constantine A. Balanis, "Antenna Theory Analysis and Design", John Wiley & Sons, 4th edition, 2016.
2. John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antennas for All Applications", Tata McGraw-Hill, 2002.
3. R.C.Johnson and H.Jasik, "Antenna Engineering hand book", Mc-Graw Hill, 1984.
4. I.J.Bhal and P.Bhartia, "Micro-strip antennas", Artech house, 1980.

Course outcomes :

Upon successful completion of the course, the student 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.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	1					1			
CO2	2	1	3	-	1	1					2			
CO3	3	2	2	2	2	2					3	2	2	2
CO4	2	2	2	2	2	1					3	2	2	2

CHN03- Wireless and Mobile Communications

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **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.

UNIT-I

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, Mobility Management, Call Flows in GSM.2.5 G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), 2.75 G Standards: EDGE.

. **UNIT-II**

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-III

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-IV

Equalization, Diversity: Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving

UNIT-V

Code Division Multiple Access: Introduction to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing, soft Handoff, Evolution of IS 95 (CDMA One) to CDMA 2000, CDMA 2000 layering structure and channels.

Higher Generation Cellular Standards:3G Standards: evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G.

Text Books :

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. T.S.Rappaport, “Wireless Communications Principles and Practice”, 2nd edition, PHI,2002.
4. William C.Y.Lee, “Mobile Cellular Telecommunications Analog and Digital Systems”, 2nd edition, TMH, 1995.
5. Asha Mehrotra, “A GSM system Engineering” Artech House Publishers Bosten, London, 1997.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Apply frequency-reuse concept in mobile communications, and to analyze its effects on interference, system capacity, handoff techniques .
2. Distinguish various multiple-access techniques for mobile communications 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 functioning with knowledge of forward and reverse channel details, advantages and disadvantages of using the technology

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1					1			
CO2	3		3		1	1					2			
CO3	3	2	2	3	1	1					3	3	3	3
CO4	3	2	2	2	1	1					3	3	3	3

ECHN04- Voice and Data Networks

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description:
This course provides an introduction to voice and data networking technologies, including public and priv ate 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.

UNIT-I

Network Design Issues, Network Performance Issues, Network Terminology, centralized and distributed approaches for networks design, Issues in design of voice and data networks

. **UNIT-II**

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-III

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-IV

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-V

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.

Text Books :

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

Course outcomes :
Upon successful completion of the course, the student will be able to:

1. Understand Protocol, algorithms, trade-offs rationale.
2. Analyze Routing, transport, DNS resolutions
3. Know about Network extensions and next generation architectures
4. Analyze and design voice and data networking technologies

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1						1			
CO2	3		3		1	1					2			
CO3	3	2	2	3	2							3	3	3
CO4	3	2	2	2	2	2						3	3	3

ECHN05- Advanced Communication Networks

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: 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.

UNIT-I

Overview of Internet-Concepts, challenges and history. Overview of -ATM. TCP/IP Congestion and Flow Control in Internet-Throughput analysis of TCP congestion control. TCP for high bandwidth delay networks. Fairness issues in TCP.

. UNIT-II

Real Time Communications over Internet. Adaptive applications. Latency and throughput issues. Integrated Services Model (intServ). Resource reservation in Internet. RSVP.

Characterization of Traffic by Linearly Bounded Arrival Processes (LBAP). Leaky bucket Algorithm and its properties.

UNIT-III

Packet Scheduling Algorithms-requirements and choices. Scheduling guaranteed service connections. 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-IV

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 based admission control. Differentiated Services in Internet (DiffServ). DiffServ architecture and framework

UNIT-V

IPV4, IPV6, IP tunnelling, IPswitching and MPLS, Overview of IP over ATM and its evolution to IP switching. MPLS architecture and framework. MPLS Protocols. Traffic engineering issues in MPLS.

Text Books :

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.

Course outcomes :

Upon successful completion of the course, the student 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.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1					1			
CO2	3		3		1	1					2			
CO3	3	2	2	3	2	2					3	3	3	3
CO4	3	2	2	2	2	2					3	3	3	3

ECHN06- Pattern Recognition and Machine Learning

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **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.

UNIT-I

Introduction to Pattern Recognition: Problems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes rule, discriminant functions, loss functions and Bayesian error analysis

UNIT-II

Linear models: Linear Models for Regression, linear regression, logistic regression Linear Models for Classification.

UNIT-III

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-IV

Linear discriminant functions - decision surfaces, two-category, multi-category, minimum-squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine

UNIT-V

Algorithm independent machine learning – lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers

Unsupervised learning and clustering – k-means clustering, fuzzy k-means clustering, hierarchical clustering

Text Books :

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.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Study the parametric and linear models for classification
2. Design neural network and SVM for classification
3. Understand Linear discriminant functions
4. Develop machine independent and unsupervised learning techniques.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1					1			
CO2	3		3		1	1					2			
CO3	3	2	2	3	2	2					3	3	3	3
CO4	3	2	2	2	2	2					3	3	3	3

Courses offered for Minors in Electronics

ECMN01(EC 104)- Electronic Devices

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: This course develops a basic understanding of the fundamentals and principles of analog and digital circuits and electronic devices. This understanding is a critical step towards being able to design new electronic circuits or use them appropriately as part of a larger engineering system.

Course Objectives:

1. To familiarize the student with the principal of operation, analysis and design of junction diode, BJT and FET transistors and amplifier circuits.
2. To understand diode as a rectifier.
3. To study basic principal of filter of circuits and various types

UNIT-I

Semiconductor Materials: Atomic structure, Electrons in periodic Lattices, Classifying Materials: Semiconductors, conductors and insulators, Semiconductor material groups, Covalent bonding, Energy Band gaps, Energy bands in intrinsic and extrinsic silicon /Germanium, Density of Impurity States, Electrical Conductivity and Mobility, , Electronic Properties of N-type and P-type semiconductors, Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors. Generation and recombination of carriers; Poisson and continuity equation, P-N junction characteristics, I-V Characteristics, and small signal switching models, Diode resistances and diode capacitances.

UNIT-II

Diode models, Avalanche breakdown, Zener diode, Schottky diode, Tunnel diode, Varactor diode and their applications, Testing a diode.

Rectifiers: Diode equivalent circuits, Analysis of diode circuits, Characteristics and comparison of Half-wave, Full-wave and Bridge rectifiers, Analysis of filters (C, L, LC, and CLC) used with Full-wave rectifiers, line regulation and load regulation.

UNIT-III

Bipolar Junction Transistors: Bipolar Junction Transistor action, PNP and NPN transistors, CB, CE, and CC configurations and their I-V characteristics, Analytical expressions for transistor characteristics, Typical junction voltages and maximum ratings. Determination of h-parameters from BJT characteristics, Ebers-Moll Model, Multi Emitter transistor.

UNIT-IV

Bipolar Junction Transistor Biasing: Operating point, stabilization, thermal runaway.

Field Effect Transistors: Characteristics and parameters of JFET, Pinch off and saturation regions, MOS capacitor, Depletion and Enhancement type of MOSFET, I-V characteristics, and small signal models of MOS transistor, UJT and its I-V characteristics, Metal Semiconductor FET, FET biasing schemes.

UNIT-V

Optoelectronic Devices: Principle of operation and characteristics of LED. LCD, LDR, Photoconductor, Photodiode, Phototransistor, Solar cell, PIN photodiode, Charge-Coupled Devices, APD (avalanche photodiode) and their applications.

Power Semiconductor Devices: Device structure, equivalent circuit and characteristics of PNPN Diode, SCR, DIAC and TRIAC. .

Text Books :

1. 1.Ben G. Steetman and Sanjay Kumar Banerjee, “Solid State Electronic Devices,” 7th edition,

Pearson Publishers, 2015.
2. Jacob Millman, Christos Halkias, Chetan D Parikh, "**Integrated Electronics**: Analog and Digital Circuits and Systems", 2nd Edition, Tata Mcgraw Hill Ed. Private Limited, 2011.
3. Allen Mottershead, "Electronic Devices and Circuits**:** An Introduction", PHILearning , 2011.
4. D. Neamen , D. Biswas "Semiconductor Physics and Devices", McGraw-Hill Education.
5. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley & Sons, 2006.
6. C.T. Sah, "Fundamentals of solid state electronics," World Scientific Publishing Co. Inc, 1991.
7. Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford University Press, 2011.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Understand the principles of semiconductor physics of the intrinsic, *p* and *n* type materials.
2. Understand the characteristics of the diode and some special function diodes and their application in electronic circuits and rectifier circuits
3. Understand basics of transistors for circuits and systems.
4. Understand the characteristics of the Transistors biasing opto-electronic devices and Power Semiconductor Devices and their application in electronic circuits.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**2**		
CO2	**3**	**3**	**2**	**2**	**1**	**-**	**1**	**-**	**1**	**-**	**-**	**2**	1	
CO3	**2**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**2**		
CO4	**3**	**2**	**3**	**3**	**1**	**-**	**-**	**-**	**1**	**-**	**1**	**1**		1

ECMN02(EC305C)**- Digital Logic Design**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: This course develops a basic understanding of the fundamentals and principles of Logic circuits and VLSI Design flow. This understanding is a critical step towards being able to design new Logic circuits or use them appropriately as part of a larger engineering system

Course Objectives:

1. To familiarize the student with Basic Logic circuits and designing.

2. To learn the design concepts of MSI devices, Sequential Logic Design and VLSI Design flow.

UNIT I

Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion**.**

UNIT II

MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU**.**

UNIT III

Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudorandom Binary Sequence generator.

UNIT IV

Clock generation Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices**.**

UNIT V

VLSI Design flow: Design entry, Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

Text / Reference Books:

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd Edition,2006.
4. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989
5. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition 2012.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Design and analyze combinational logic circuits.
2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder.
3. Design & analyze synchronous sequential logic circuits.
4. Use HDL & appropriate EDA tools for digital logic design and simulation

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	1	-	-	2	1	
CO2	3	3	2	2	1	-	2	-	1	-	-	2		
CO3	2	2	2	2	1	-	-	-	1	-	1	2		1
CO4	3	2	3	3	1	-	2	-	1	-	1	1		

ECMN03(EC306C)**- Analog Circuits**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: This course develops a basic understanding of the fundamentals and principles of analog circuits and electronic devices in electrical and electronic engineering.

Course Objectives:

1. To specify the small signal equivalent model of transistors
2. To analyze transistor amplifier circuits
3. To design multistage transistor amplifier circuits
4. To identify and discuss operating principles of differential amplifiers
5. To design and analyze integrated circuit biasing
6. To analyze frequency response of linear amplifiers

UNIT-I

General Amplifiers Characteristics: Concept of Amplifier, Voltage gain, Current gain, Power gain, Input and Output resistances, Conversion efficiency, Frequency response, Bandwidth, Distortion,

BJT Amplifiers: Small signal low frequency model of the transistor, Analysis of CE, CB and CC amplifiers, Approximate model analysis, Effects of coupling and bypass capacitors on low frequency response, Hybrid-Π model at high frequencies, Calculation of High-Frequency parameters in terms of Low Frequency parameters, CE short circuit gain, CE current gain with resistive load.

UNIT-II

FET Amplifiers: Small signal model, Analysis of CS, CD and CG amplifiers, comparison of performance of the three configurations, High frequency FET circuits, CS amplifier at high frequencies, CD amplifier at high frequencies.

Multistage Amplifiers: Types of coupling, Choice of amplifier configuration, overall voltage gain and Bandwidth of n-stage amplifier, Darlington and Bootstrap circuits.

UNIT-III

Feedback amplifiers: Feedback concept, Classification, Effects of negative feedback on gain, Stability, Noise, Distortion, Bandwidth, input resistance and output resistance.

Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), Crystal oscillators.

UNIT-IV

Power Amplifiers: Series-Fed Class-A power amplifiers, Transformer coupled class-A power amplifiers, Push-pull amplifiers, Class-B amplifiers, Class-AB operation, Complementary symmetry Push-Pull class-B Power amplifiers

Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load

UNIT-V

Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR, circuits to improve CMRR, transfer characteristics.

Operational Amplifier: Ideal op-amp characteristics, Op-amp internal circuit, examples of IC op-amps, DC and AC characteristics, Inverting and non-inverting modes of operation, voltage follower.

Text Books :

1. Millman and Halkias, “Integrated Electronics”, McGraw-Hill Co
2. Mottershed, “Electronic devices and circuits”, PHI
3. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
4. Salivahanan, “Electronic Devices and circuits”, TMH.
5. David A. Bell, “Electronic Devices and circuits”, PHI
6. D.Roy Choudary, Shail Bala Jain, “Linear Integrated circuits”, New Age International publishers,

2018.
7. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
8. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
9. Adel S. Sedra, Kenneth C. Smith, Microelectronic Circuits, Saunder's College Publishing, IV Edition.
10. Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition.

Course outcomes :
Upon successful completion of the course, the student will be able to:

1. Design and analyze various amplifier circuits.
2. Design sinusoidal oscillators.
3. Understand the functioning Power Amplifiers, Differential amplifier..
4. Understand the functioning of OP-AMP and design OP-AMP based circuits.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	1	-	-	2	1	-
CO2	2	2	2	2	1	-	1	-	1	1	-	2	-	-
CO3	2	2	2	2	1	-	-	-	1	-	-	2	-	-
CO4	3	2	3	2	1	-	-	1	1	-	-	1	-	1

ECMN04(EC404C) - IC Applications

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: The main aim of this lab is to teach the linear and non-linear applications of operational amplifiers (741). Students are made familiar with theory and applications of 555 timers. Students are made to Design combinational logic circuits using digital ICs.

Course Objectives:

1. To introduce the basic building blocks of linear integrated circuits.
2. To teach the linear and non - linear applications of operational amplifiers
3. To introduce the theory and applications of analog multipliers and PLL.
4. To understand and implement the working of basic digital circuits

UNIT-I

Op-Amp Applications: Scale changer/inverter, Summing amplifier, Instrumentation amplifier, Instrumentation amplifier IC-AD620, DC and AC amplifiers, V to I and I to V converters, Precision rectifiers, Log and Antilog amplifiers, multiplier and divider, Analog multiplier IC-AD633, Differentiator, Integrator, Analog computation.

. **UNIT-II**

Comparators and waveform generators: Comparator, Regenerative comparator (Schmitt Trigger), Astable and mono-stable multi-vibrators using op-amp, Triangular wave generator, Sine wave generators using op-amp. IC waveform generator (8038).

UNIT-III

Voltage regulators: Series op-amp regulator, IC voltage regulators, 723 General purpose regulator, Switching regulators.

Active filters: Low pass, high pass, band pass, band reject and all pass filters, transformation, State variable filter, Switched capacitor filters, Switched capacitor filter ICs.

UNIT-IV

555 Timer: Description of functional diagram, Monostable operation. Applications in monostable mode, Astable operation, Applications in astable mode, Schmitt trigger.

Phase Locked Loops: PLL- introduction, block schematic, principles and description individual blocks, IC PLL (565), Voltage controlled oscillator (566), PLL applications- Frequency multiplication, Frequency translation, FM & FSK demodulation.

UNIT-V

D-A and A-D Converters: Basic DAC Techniques, Weighted resistor DAC, R-2R ladder DAC, Inverted R-2R ladder, Monolithic DAC IC-1409, A-D converters, direct type ADCs, the parallel comparator(flash) A/D converter, The counter type A/D converter, Servo tracking A/D converter, Successive approximation converter, Integrating type of ADCs, Charge balancing ADC, Dual-slope ADC, DAC/ADC specifications.

Text Books :

1. D.Roy Choudary, Shail Bala Jain, “Linear Integrated circuits”, New Age International publishers, 2018.
2. Ramakant A.Gayakward, “Op-amps and linear Integrated circuits”, LPE, 4th edition, Pearson Education.
3. S.Salivahanan, V.S.Kanchana Bhaaskaran “Linear Integrated circuits”, TMH, 2008.
4. David A. Bell, “Operational amplifiers and Linear ICs”, PHI, EEE, 1997.
5. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992. Sons, 1975.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Understand the functioning of OP-AMP and design OP-AMP based circuits.
2. Understand the functioning of voltage regulators and design IC based voltage regulators,
3. Understand the functioning of 555 timer and design 555 timer based circuits.
4. Understand the functioning of PLL and design PLL based circuits.
5. Design ADC and DAC circuits.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	-	-	-	1	-	-	2	1	-
CO2	2	2	2	2	1	-	1	-	1	1	-	2	-	-
CO3	2	2	2	2	1	-	-	-	1	-	-	2	-	-
CO4	3	2	3	2	1	-	-	1	1	-	-	1	-	1

ECMN05(EC604C-Program Elective-II)**- Electronic Instrumentation**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: This course deals with the basics of electronic instruments used in laboratory and industry. In the process they learn different type of instruments like voltmeter, ammeter, Q meter, Bridges, transducers and display devices CRO, CRT. After learning this subject student will be master in working principle and application of all types of instruments.

Course Objectives:

1. To explain basic concepts and definitions in measurement.
2. To describe the bridge configurations and their applications.
3. To understand, design aspects and performance criterion of measuring instruments.
4. To understand the working principle of various transducers.

UNIT-I

Measurement and Error: Definitions, accuracy and precision, types of errors.
DC Ammeters, DC Voltmeters, Series type ohmmeter, Shunt type ohmmeter. AC Voltmeter using rectifiers, True RMS responding voltmeter. Analog Instruments – Transistor voltmeter, micro voltmeter (chopper type) - DC differential voltmeter - AC voltmeters.

UNIT-II

Cathode Ray Oscilloscopes : Motion of electron in electric field and in magnetic field – Block diagram of CRO, CRT, Electrostatic deflection sensitivity – Vertical and Horizontal deflection systems – Principle of operation of Dual beam, Digital, Dual trace, Sampling and Storage CROs – Measurements with CRO (voltage, current, time, frequency, phase angle, Lissajous figures).

UNIT-III

Q meter and measurement methods.
Bridges: Wheatstone, Kelvin's, Maxwell, Hay and Schering bridges.
Wave analyzers (AF & RF) - Harmonic distortion analyzers – Spectrum analyzer.

UNIT-IV

Digital instruments – Digital voltmeters (Ramp, Dual slope, stair case, successive approximation types) Digital Multimeter, universal counter, Digital tachometer, Digital phase meter IEEE 488 Bus.

UNIT-V

Transducers – Classification and selection of transducers – strain gauges – Temperature measurement (resistance thermometer, thermo couples and thermistors) LVDT – Peizo electric transducer..

Text Books :

1. 1. H.S.Kalsi, "Electronic Instrumentation" TMH, 1995.
2. Helfric and Cooper, "Modern Electronic Instrumentation and measurement techniques", PHI, 1995.
3. A.K.Sawhney , " Electrical and electronic measurements and instrumentation", Danapat Rai & Co.,18th edition., 2007.

E-resources and other digital material
1.https://nptel.ac.in/courses/108106070
2.https://nptel.ac.in/courses/108106070

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Emphasize the basic electronics measurement concepts & Design the different analog and digital electronics voltmeters
2. Identify and use different analyzers oscilloscopes.
3. Design the Measurement of different bridges& generators to make measurements and analyze measurement.
4. Analyze the concepts of Transducers based on application

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**2**		
CO2	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**2**	1	
CO3	**2**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**2**		1
CO4	**3**	**2**	**3**	**3**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	1	

ECMN06(EC603C --Program Elective-I)**- CMOS VLSI Design**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: This is an introductory course that covers basic theories and techniques of digital VLSI design in CMOS technology. In this course, we will study the fundamental concepts and structures of designing digital VLSI systems including CMOS devices and circuits, standard CMOS fabrication processes, CMOS design rules, static and dynamic logic structures, interconnect analysis, CMOS chip layout, simulation and testing, low power techniques, design tools and methodologies, VLSI architecture.
Prerequisite Courses: Electronic Devices, Analog Circuits and Digital Logic Design.

Course Objectives:

1. To learn basic CMOS Circuits.
2. To learn CMOS process technology.
3. To learn techniques of chip design using programmable devices.
4. To learn the concepts of designing VLSI Subsystems

UNIT-I

Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography and twin-tub CMOS process.
Brief Introduction to MOS, PMOS, NMOS, CMOS & BiCMOS technologies. Review of MOS transistor models, Non-ideal behavior of the MOS Transistor, $I_{ds} - V_{ds}$ relationships, MOS transistor threshold Voltage, Transistor as a switch, Inverter characteristics**.**

UNIT-II

Integrated Circuit Layout: VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for CMOS Inverters and Gates, Scaling of MOS circuits.
Basic Circuit Concepts: Sheet Resistance R_s and its concepts to MOS, Area Capacitance calculations, Inverter Delays, driving large Capacitive Loads, Wiring Capacitances. Delay: RC Delay model, linear delay model, logical path efforts. Power, interconnect and Robustness in CMOS circuit layout

UNIT-III

Combinational Circuit Design: CMOS logic families including static, dynamic and dual rail logic, Switch logic, Alternate gate circuits. Shifters, Adders, Parity generators, Comparators, Zero/One Detectors, Binary Counters, ALUs, Multipliers, Counters, High Density Memory Elements.

UNIT-IV

Sequential Circuit Design: Static Circuits, Design of latches and Flip-flops.
Test and Testability: Fault-modeling and simulation, test generation, design for testability, Built-in-self-test.

UNIT-V

Physical Design: Floor-Planning, Placement, routing, Power delay estimation, Clock and Power routing.
Design styles: Full-custom, Standard Cells, Gate-arrays, FPGAs, CPLDs and Design Approach for Full-custom and Semi-custom devices. .

Text Books :

1. 1 Neil H.E. Weste and David Money Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4th Edition, Pearson Education India, 2015.
2. Kamran Eshraghian, Eshraghian Douglas and A. Pucknell, Essentials of VLSI circuits and systems, PHI, 2005 Edition.
3. John M. Rabaey, A. Chandrakasan, B. Nikolic, Digital Integrated Circuits: A Design Perspective", 2nd Edition, Pearson, 2016.

Course outcomes :
Upon successful completion of the course, the student will be able to:

1. Learn CMOS process technology.
2. Analyze and implement various CMOS static logic circuits using Lambda based design rules.
3. Design different CMOS circuits using various logic families along with their circuit layouts for subsystem design.
4. To learn techniques of chip design using programmable devices and use HDL tools for designing VLSI Subsystems.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3					-	-	-		-	-			
CO2	2	1	3							-	-		1	
CO3	2			3		-	-	-		-	-			
CO4	2	1				-	-	-		-	-			1

Courses offered for Minors in Communications

ECMN11((EC303C))- Signals and Systems

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: This course focuses on analyzing signals (sound, voltage, communication transmissions, pressure, images, etc.) and the systems that act on them (circuits, physical echos, mechanical dynamics, modulation, etc.). We concentrate on the Fourier transform and linear-time invariant systems, providing a depth of tools for sampling, manipulating, preserving, and interpreting information signals

Course Objectives:

1. To represent and classify signal and systems.
2. Represent and apply singularity functions.
3. Obtain the response of a continuous, linear, time-invariant, causal system by using convolution.
4. Obtain the Fourier series expansion of a periodic signal and apply it to continuous, linear, time-invariant systems.
5. Obtain and plot the Fourier transform for simple a periodic continuous-time signals.

UNIT-I

Introduction to Signals and Systems:

Definition and classification of signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character, Elementary signals such as Impulse, step, ramp, sinusoidal and exponential signals, Operations on signals. Basic System Properties (Continuous-Time and Discrete-Time): linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability, Examples, Causal LTI Systems Described by Differential and Difference Equations.

Signal Analysis:

Analogy between vectors and signals, Orthogonal signal space, Signal approximation using orthogonal functions, Mean square error, Closed or complete set of orthogonal functions, Orthogonality in complex functions.

UNIT-II

Fourier series and Fourier Transform:

The Response of LTI Systems to Complex Exponentials. Fourier series Representation of Continuous-Time Periodic Signals, Convergence of the Fourier series, Properties of Continuous-Time Fourier Series. The Continuous-Time Fourier Transform – properties. Discrete-Time Fourier Transform – Properties, Basic Fourier Transform Pairs. Introduction to Hilbert Transform.

UNIT-III

Convolution and Correlation of Signals:

Concept of convolution in time domain and frequency domain, Graphical representation of convolution, Convolution property of Fourier transforms, Cross correlation and auto correlation of functions, properties of correlation function, Energy density spectrum, Parseval's theorem, Power density spectrum, Relation between auto correlation function and energy/power spectral density function. Relation between convolution and correlation, Detection of periodic signals in the presence of noise by correlation, Extraction of signal from noise by filtering.

UNIT-IV

Behaviour of continuous and discrete-time LTI systems:

The Magnitude-Phase Representation of the Fourier Transform, The Magnitude-Phase Representation of the Frequency Response of LTI Systems, Distortion less transmission through a system, signal bandwidth, system bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and Poly-Wiener criterion for physical realization, relationship between bandwidth and rise time, State-space Representation of systems, State-Space Analysis, Multi-input, multi-output representation.

Sampling and Reconstruction:

The Sampling Theorem and its implications, Spectra of sampled signals, Reconstruction: ideal interpolator, zero-order hold, first-order hold, Aliasing and its effects. Relation between continuous and discrete time systems, Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

UNIT-V

The Laplace Transform -The Region of Convergence - Properties, The Inverse Laplace Transform, Laplace Transform Pairs, Analysis and Characterization of LTI Systems Using the Laplace Transform, Unilateral Laplace Transform. The Z-Transform -Region of Convergence - Properties, The Inverse z-Transform, Common z-Transform Pairs, Analysis and Characterization of LTI Systems Using z-Transforms, Unilateral z-Transform.

Text Books :

1. 1.Alan V. Oppenheim, Alan S. Willsky, & S. Hamid Nawab, “Signals and Systems,” Pearson Higher Education, 2nd Ed., 1997.
2. J. G. Proakis and D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms, and Applications”, Pearson, 2006.
3. Simon Haykin and B. Van Veen, “Signals & Systems,” John Wiley and Sons, 2nd Edition, 2007.
4. B.P. Lathi, “Principles of LINEAR SYSTEMS and SIGNALS,” Oxford Univ. Press, Second Edition, International version, 2009.
5. H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, 2010.
6. Luis F. Chaparro, “Signals and Systems using MATLAB,” Academic Press, 2011.
7. C. L. Philips, J. M. Parr and Eve A. Riskin, “Signals, Systems and Transforms,” Pearson Education, 4th Edition, 2008.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Analyze different types of signals
2. Understand the concepts of continuous time and discrete time systems.
3. Analyze systems in complex frequency domain.
4. Investigate whether the system is stable or not.
5. Understand sampling theorem and its implications

Mapping of course outcomes with program outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	--	--	--	--	--	--	--	--	--	--	3	1	--
CO2	--	1	--	--	--	2	--	--	--	2	--	2	--	1
CO3	2	2	2	--	--	--	--	--	--	--	2	2	1	--
CO4	2	2	--	--	--	--	--	--	--	--	--	2	--	1

ECMN12(EC402C)**- Probability theory & Stochastic Process**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: This course explanations and expositions of probability and stochastic processes concepts which they need for their experiments and research. It also covers theoretical concepts of probability and stochastic processes pertaining to handling various stochastic modeling.

Course Objectives:

1. To provide mathematical background and sufficient experience so that student can read, write and understand sentences in the language of probability theory.
2. To introduce students to the basic methodology of "probabilistic thinking" and apply it to problems.
3. To understand basic concepts of Probability theory and Random Variables, how to deal with multiple Random Variables.
4. To understand the difference between time averages statistical averages

UNIT-I

Sets and set operations, Probability space, Conditional probability Total Probability, and Bayes theorem, Combinatorial probability and sampling models.

Discrete random variables, probability mass function, probability distribution function, example random variables and distributions. Continuous random variables, probability density function, probability distribution function, example distributions

UNIT-II

Joint distributions, functions of one and two random variables, moments of random variables; Conditional distribution, densities and moments, Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds.

UNIT-III

Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, Central Limit Theorem, (Proof not expected), Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variables.

UNIT-IV

Random Process: Classification of Processes, Stationary processes, Mean and covariance functions, Time Averages and Ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes, Autocorrelation Function & Its Properties, Cross-Correlation Function & its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process.

Power spectral density, Properties, Relationship between Power Spectrum and Autocorrelation Function, The Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function.

UNIT-V

Transmission of random process through LTI systems: System Response – Convolution, Mean and Mean-squared Value of System Response, autocorrelation Function of Response, Cross-Correlation Functions of Input and Output, Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectrums of Input and Output, properties of white noise, Band pass, Band-Limited and Narrowband Processes, Properties

Text Books :

1. H. Stark and J. Woods, "Probability and Random Processes with Applications to Signal Processing", 3rd Edition, Pearson Education.
2. Athanasios Papoulis and S. Unnikrishnan Pillai, "Probability, Random Variables and Stochastic Processes", PHI, 4th Edition, 2002.
3. Peyton Z. Peebles, "Probability, Random Variables & Random Signal Principles", Tata McGraw Hill, 4th Edition, 2001.
4. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International.
5. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers.
6. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers.
7. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Understand representation of random signals.
2. Investigate characteristics of random processes.
3. Make use of theorems related to random signals.
4. Able to Model of different Noise Sources and to understand propagation of random signals in LTI systems

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	--	--	--	--	--	--	--	--	--	--	3	1	--
CO2	--	1	--	--	--	2	--	--	--	2	--	2	--	1
CO3	2	2	2	--	--	--	--	--	--	--	2	2	1	--
CO4	2	2	--	--	--	--	--	--	--	--	--	2	--	1

ECMN13 (EC405C)- **Analog Communications**	
Instruction: Hours/Week: **3L:0T:0P**	**Credits: 3**
Sessional Marks: **40**	End Semester Examination Marks: **60**

Course Description: This course gives concepts of Different Analog communications which they need for their experiments and research.

Course Objectives: To understand

1. The concepts of various Amplitude, Angle and Pulse Modulation schemes and information theory with random processes.
2. The working principle of Radio Receivers

. **Unit – I**

Introduction: Elements of communication systems, Information, Messages and Signals, Modulation, Modulation Methods, Modulation Benefits and Applications.

Amplitude Modulation & Demodulation: Baseband and carrier communication, Amplitude Modulation

(AM), Rectifier detector, Envelope detector, Double sideband suppressed carrier (DSB-SC) modulation & its demodulation, Switching modulators, Ring modulator, Balanced modulator, Frequency mixer, sideband and carrier power of AM, Generation of AM signals, Single sideband (SSB) transmission, Time domain representation of SSB signals & their demodulation schemes (with carrier, and suppressed carrier), Generation of SSB signals, Vestigial sideband (VSB) modulator & demodulator, Frequency division multiplexing (FDM), Illustrative Problems.

UNIT-II

Angle Modulation & Demodulation: Concept of instantaneous frequency, Generalized concept of angle

modulation- Frequency Modulation & Phase modulation : Bandwidth of angle modulated waves, Narrow band frequency modulation (NBFM) and Wide band FM (WBFM), Verification of Frequency modulation bandwidth relationship, Features of angle modulation, Generation of FM waves-Indirect method, Direct generation; Demodulation of FM, Band pass limiter, Practical frequency demodulators, Small error analysis, Pre-emphasis, & De-emphasis filters, FM Capture Effect, Illustrative Problems.

UNIT-III

Noise in Communication Systems: Thermal noise, Time domain representation of narrowband noise, filtered white noise, Quadrature representation of narrowband noise, Envelope of narrowband noise plus sine wave, Signal to noise ratio & probability of error, Noise equivalent bandwidth, Effective noise temperature, and Noise figure, Baseband systems with channel noise, Performance analysis (i.e. finding SNR expression) of AM, DSBSC, SSB-SC, FM, PM in the presence of noise, Illustrative Problems.

UNIT-IV

Radio Receivers: Working principle of Super heterodyne AM and FM Receivers along with suitable block diagrams, Sensitivity, Selectivity and fidelity.

Analog Pulse Modulation Schemes: Pulse amplitude modulation – Natural sampling, flat top sampling and Pulse amplitude modulation (PAM) & demodulation, Pulse-Time Modulation – Pulse Duration and Pulse Position modulations, and demodulation schemes, PPM spectral analysis, Illustrative Problems.

UNIT-V

Information Theory: Introduction, Information and Entropy, and its properties, source coding Theorem, Data Compaction – Prefix coding, Huffman coding, Discrete Memory less channels, Mutual Information, and its properties, Channel capacity, Channel coding Theorem, Application to binary symmetric channels, differential entropy and mutual information, Information capacity theorem, implication of information capacity theorem, Rate Distortion, Illustrative problems

Text Books:

1. B. P. Lathi, "Modern Digital and Analog Communication Systems," Oxford Univ. press, 3rd Edition, 2006.
2. Simon Haykin, "Communication Systems," by John Wiley & Sons,3rdEdition, 2010.
3. Sham Shanmugam, "Digital and Analog Communication Systems", Wiley-India edition, 2006.

REFERENCES:

1. Bruce Carlson, & Paul B. Crilly, "Communication Systems – An Introduction to Signals & Noise in Electrical Communication", McGraw-Hill International Edition, 5th Edition, 2010.
2. Herbert Taub&Donald L Schilling, "Principles of Communication Systems", Tata McGraw-Hill, 3rd Edition, 2009.
3. . R.E. Ziemer& W.H. Tranter, "Principles of Communication-Systems Modulation & Noise", Jaico Publishing House, 5thedition, 2001.
4. George Kennedy and Bernard Davis, "Electronics & Communication System", TMH,2004.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Understand the concepts of various Amplitude, Angle and Pulse Modulation schemes and information theory with random processes and to solve problems in analog and pulse modulation schemes
2. Analysis of analog communication system in the presence of noise.
3. Compare and contrast design issues, advantages, disadvantages and limitations of various modulation schemes in analog communication systems.
4. Solve basic communication problems & calculate information rate and channel capacity of a discrete communication channel.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	--	--	--	1	--	--	--	--	--	--	3	1	--
CO2	3	1	2	--	2	2	--	1	--	2	--	2	--	1
CO3	2	2	2	--	--	--	--	1	--	--	2	2	1	--
CO4	2	2	2	--	1	--	--	--	--	--	--	2	--	1

ECMN14(EC505C) **- Digital Communications**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description:

This course provides an introduction to voice and data networking technologies, including public and pri vate voice services, Ethernet and Internet data technologies, network security, business applications and network management. The structure, regulation, andhistory of the telecom and data network industry wil l 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.

UNIT I

Source Coding Systems: Sampling, Quantization, Quantization noise, Encoding, Pulse Code Modulation (PCM), Line codes, Regeneration, Decoding and Filtering, Noise considerations in PCM systems, Time-Division Multiplexing (TDM), Synchronization, Differential encoding, Delta modulation (DM), Differential Pulse Code Modulation (DPCM), Processing gain, Adaptive Delta Modulation (ADM).

UNIT II

Introduction to Baseband Pulse Transmission, Matched filter and it's Properties,Matched filter for rectangular pulse, Error rate due to noise, Inter-symbol Interference (ISI), Nyquist's criterion for distortion less baseband binary transmission, Duo binary, Modified duo binary in Correlative-level coding, Baseband M-array PAM transmission, Eye diagrams.

UNIT III

Signal Space Analysis: Introduction, Geometric representation of signals, Gram-Schmidt Orthogonalization procedure, Conversion of the Continuous AWGN channel into a vectorchannel, Coherent detection of signals in noise, Correlation receiver, Probability of error**.**

UNIT IV

Passband Data Transmission: Introduction, Passband transmission model, ASK, Coherent Phase Shift Keying – Binary phase shift keying (BPSK), Quadrature shift keying (QPSK), Binary Frequency shift keying (BFSK), M-array Quadrature Amplitude Modulation (M-array QAM), Non-coherent orthogonal modulation schemes-Differential PSK, Non-Coherent Binary FSK.

(Error probability, Generation and Detection, Power spectra, signal constellation diagram of above schemes)

UNIT-V

Error Control Coding: Repetition & Parity Check Codes, Interleaving, Code Vectors and Hamming Distance, Forward Error Correction (FEC)Systems, Linear Block Codes, Cyclic Codes, Convolutional Encoding methods- Code Tree, Trellis and State Diagram, Decoding Methods- Sequential, Viterbi.

Text Books :

1. Simon Haykin, "Communication Systems," by John Wiley & Sons,3rd Edition, 2010.
2. Sam Shanmugam, "Digital and Analog Communication Systems", Wiley-India edition, 2006.

REFERENCES:

1. B. P. Lathi, "Modern Digital and Analog Communication Systems," Oxford Univ. press, 3rd Edition, 2006.
2. J.S. Chithode, "Digital Communications", Technical Publications, Ist Edition, 2020

3. Bruce Carlson, & Paul B. Crilly, "Communication Systems – An Introduction to Signals & Noise in Electrical Communication", McGraw-Hill International Edition, 5th Edition, 2010.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Understand the Digital communication System and able to analyse the different Digital modulation techniques.
2. Understand the concepts of baseband digital modulation schemes and Inter Symbol Interference.
3. Analyze Signal space concepts, probability of error performance of various digital binary modulation systems and are able to design digital communication systems.
4. Design a system with Error correcting codes by learning Block Codes, Cyclic Codes and Convolution Codes.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	-	-	-	-	-	-	-	-	3	2
CO2	2	1	1	2	-	-	-	-	-	-	-	-	2	3
CO3	1	1	1	1	-	-	-	-	-	-	-	-	3	2
CO4	1	1	1	2	1	-	-	-	-	-	-	1	2	2

ECMN15(EC504C) **Antenna Wave Propagation**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: 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 understand the concept of radiation, antenna definitions and significance of antenna parameters, to derive and analyze the radiation characteristics of thin wire dipole antennas and solve numerical problems.
2. To analyse the characteristics and design relations of UHF, VHF and Microwave Antennas.
3. To identify the antenna array requirements, to determine the characteristics of ULAs and estimate the patterns of BSA, EFA, and Binomial Arrays.
4. To understand the concepts and set-up requirements for microwave measurements, and familiarize with the procedure to enable antenna measurements.
5. To define and distinguish between different phenomenon of wave propagation (ground wave, space wave and sky wave), their frequency dependence, and estimate their characteristics, identifying their profiles and parameters involved.

UNIT-I

Antenna Basics: Basic Antenna Parameters – Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity-Gain-Resolution, Antenna Apertures, Effective Height. Fields from Oscillating Dipole, Field Zones, Front - to-back Ratio, Antenna Theorems, Radiation,
Retarded Potentials–Helmholtz Theorem
Thin Linear Wire Antennas – Radiation from Small Electric Dipole, Quarter Wave Monopole and Half Wave Dipole – Current Distributions, Field Components, Radiated Power, Radiation Resistance, Beam Width, Directivity, Effective Area and Effective Height, Natural Current Distributions, Far Fields and Patterns of Thin Linear Centre-fed Antennas of Different Lengths. Loop Antennas.

UNIT-II

Antenna Arrays: Point Sources – Definition, Patterns, arrays of 2 Isotropic Sources - Different Cases, Principle of Pattern Multiplication, Uniform Linear Arrays – Broadside Arrays, End fire Arrays, EFA with Increased Directivity, Derivation of their Characteristics and Comparison, BSAs with Non-uniform Amplitude Distributions – General Considerations and Binomial Arrays.

UNIT-III

VHF, UHF and Microwave Antennas - I: Arrays with Parasitic Elements, Yagi-Uda Array, Folded Dipoles and their Characteristics, Helical Antennas – Helical Geometry, Helix Modes, Practical Design

Considerations for Monofilar Helical Antenna in Axial and Normal Modes, Horn Antennas – Types,Fermat's Principle, Optimum Horns, Design Considerations of Pyramidal Horns.

UNIT-IV

VHF, UHF and Microwave Antennas - II: Microstrip Antennas – Introduction, Features, Advantages and Limitations, Rectangular Patch Antennas – Geometry and Parameters, Characteristics of Microstrip Antennas. Reflector Antennas – Introduction, Flat Sheet and Corner Reflectors, Paraboloidal Reflectors – Geometry, Pattern Characteristics, Feed Methods, Reflector Types – Related Features.

UNIT-V

Ground Wave Propagation –Plane Earth Reflections, Space and Surface Waves, Wave Tilt, Curved Earth Reflections. Space Wave Propagation –Field Strength Variation with Distance and Height, Effect of Earth's Curvature, Absorption, Super Refraction, M-Curves and Duct Propagation, Scattering phenomena, Troposphere Propagation. Sky Wave Propagation –Structure of Ionosphere, Refraction and Reflection of Sky Waves by Ionosphere, Ray Path, Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation between MUF and Skip Distance, Multi-hop Propagation.

Text Books :

1. Antennas and Wave Propagation – J.D. Kraus, R.J. Marhefka and Ahmad S. Khan, TMH, New Delhi, 4th ed., (Special Indian Edition), 2010.
2. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd edition,2000.
3. Antenna Theory - C.A. Balanis, John Wiley & Sons, 3rd Ed., 2005.
4.. Antennas and Wave Propagation – K.D. Prasad, Satya Prakashan, Tech India Publications,New Delhi, 2001..

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Understand the basic parameters of antenna (L1) and apply the concepts to various antennas based on frequency, configuration and establish the radiation patterns of antenna arrays (L2)
2. Analysis of VHF, UHF and Microwave Antennas (L3)
3. Design and analysis of microstrip antennas (L4)
4. To understand the wave propagation in different frequency ranges (L5)

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	2	1	2	1	3	3		
CO2	3	3	2	2	1	2	3	2	2	1	3	3		
CO3	3	2	2	2	1	2	3	1	1	1	2	3		
CO4	3	3	2	3	2	2	3	-	1	1	2	3		

ECMN16((EC601C)- **Microwave Engineering**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: The course will be broadly focusing on analysis, design and development of microwave circuits and systems. The course will cover introduction to Microwaves, Microwave transmission modes, Transmission lines, Impedance Matching, Microwave Network Analysis, Directional Coupler, Power Divider, Microwave Filters, Microwave Attenuator, RF switches and phase shifters, Microwave Amplifiers, Low Noise Amplifier, Microwave Mixers and Oscillators, Microwave Antennas, Microwave Measurements, Microwave Systems.

Course Objectives:

1. To get familiarized with microwave frequency bands, their applications and to understand the limitations and losses of conventional tubes at these frequencies.
2. To distinguish between different types of microwave tubes, their structures and principles of microwave power generation.
3. To impart the knowledge of Scattering Matrix, its formulation and utility, and establish the S-Matrix for various types of microwave junctions.
4. Understand the utility of Optical Fibres in Communications

UNIT – I

Microwave Tubes: Limitations and Losses of conventional Tubes at Microwave frequencies,
Cavity Klystrons – Structure, Re-entrant Cavities, Velocity Modulation Process, Applegate Diagram, Bunching Process and Small Signal Theory – Expressions for O/P Power and Efficiency. Reflex Klystrons – Structure, Velocity Modulation and Applegate Diagram, Mathematical Theory of Bunching, Power Output, Efficiency, Oscillating Modes and O/P Characteristics. Helix TWTs: Types and Characteristics of Slow Wave Structures; Structure of TWT and Amplification Process(qualitative treatment), Suppression of Oscillations, Gain Considerations**.**

UNIT - II

M-Type Tubes: Introduction, Cross-field Effects, Magnetrons – Different Types, Cylindrical Traveling Wave Magnetron – Hull Cut-off and Hartree Conditions, Modes of Resonance and PI-Mode Operation, Separation of PI-Mode, o/p characteristics,
Microwave Solid State Devices: Introduction, Classification, Applications. Gunn Diodes – Principle, RWH Theory, Characteristics, Modes of Operation - Gunn Oscillation Modes, Principle of operation of IMPATT and TRAPATT Devices.

UNIT - III

Waveguide Components: Coupling Mechanisms – Probe, Loop, Aperture types. Waveguide Discontinuities – Waveguide Windows, Tuning Screws and Posts, Matched Loads. Waveguide Attenuators – Different Types, Resistive Card and Rotary Vane Attenuators; Waveguide Phase Shifters – Types, Dielectric and Rotary Vane Phase Shifters, Waveguide Multiport Junctions - E plane and H plane Tees. Ferrites– Composition and Characteristics, Faraday Rotation, Ferrite Components – Gyrator, Isolator**.**

UNIT – IV

Scattering matrix: Importance of S-matrix, Scattering Matrix Properties, Directional Couplers – 2 Hole, Bethe Hole S Parameters, [s] matrix of Magic Tee and Circulator, Measurement of S-parameters.
MICs : Advantages of MIC's, Hybrid MIC's, Strip lines and microstrip lines, Monolithic MICs

UNIT V

Microwave Measurements: Description of Microwave Bench – Different Blocks and their Features, Errors and Precautions, Measurement of Attenuation, Frequency. Standing Wave Measurements, Measurement of Low and High VSWR., Cavity Q-factor and Impedance Measurements. Antenna gain measurements.

Text Books :

1. Microwave Devices and Circuits – Samuel Y. Liao, Pearson, 3rd Edition, 2003.
2. Electronic Communications Systems- Wayne Tomasi, Pearson, 5th Edition
3. Microwave Engineering - David M. Pozar, John Wiley & Sons (Asia) Pvt Ltd., 1989, 3r ed., 2011 4t.
4. Microwave Engineering - G.S. Raghuvanshi, Cengage Learning India Pvt. Ltd., 2012
5. Kulkarni, "Microwave and Radar Engineering", Umesh publications, 1998.
6. Annapurna Das and Sisir K.Das, "Microwave Engineering" Tata Mc Graw-Hill, 2000.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Known power generation at microwave frequencies and derive the performance characteristics. (L2)
2. Understand the principles of solid state devices. (L1)
3. Distinguish between the different types of waveguide and ferrite components, and select proper components for engineering applications (L4)
4. Understand the utility of S-parameters in microwave component design (L3) and to know the measurement procedure of various microwave parameters. (L5)

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	1	2	1	2	2	3	3	1	
CO2	3	2	2	2	1	2	2	2	2	2	3	2		
CO3	3	2	2	3	1	2	2	2	1	2	3	2		1
CO4	3	2	3	3	2	2	2	1	2	1	3	3		

ECMN17(EC602C-)- Computer Networks

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: **:** Computer Networks plays an vital role in the era of communication systems in resources sharing applications. The aim of this course is to introduce the concepts of Computer networking and its applications.

Course Objectives:

To gain knowledge in developing different applications

1. To understand the basic concepts of computer networks and internet
2. To gain knowledge about the design issues of link layer and internet layer
3. To gain knowledge about the concept of connection oriented and connection less Protocols.

Unit -I

Introduction to Computer Networks and the Internet: Principles of network applications and Internet Challenges &Layering concepts.
OSI Reference Model & TCP/IP Reference Model.

Unit -II

Link layer: ALOHA, Multiple access protocols, IEEE 802 standards, Local Area Networks, Ethernet, Wireless LAN,Flow Control, Error Detection and Error Correction.

Unit -III

Internet Layer:
IP Addressing, IP Protocol, Routing Algorithms, queuing disciplines.
Congestion Control Algorithms, Resource Reservation ,Admission Control and Differentiated services

Unit -IV

Transport Layer: User Datagram Protocol, Connection oriented transport protocol– Transmission Control Protocol, Remote Procedure Call. Port Addressing and Socket Programming.

Unit –V

Application layer: The Web and Hyper Text Transfer Protocol, File transfer, Electronic mail, Domain name system, Peer-to-Peer file sharing,JPEG,MPEG .
Network Security: DES & RSA

Text Books :

1. J.F. Kurose and K. W. Ross, 1.“Computer Networking – A top down approach Pearson Education, 5th Edition
2. Andrew S Tanenbaum, “Computer Networks”, Prentice Hall India Fourth Edition.
3. Behrouz A. Forouzan, “Data Communications and Networking”, Tata McGraw Hill, 4th Edition
4. D. Comer, “Computer Networks and Internet/TCP-IP”, Prentice Hall
5. William Stallings, “Data and Computer Communication, 8th Edition, Pearson Prentice

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Design of computer networks in Internet.

2. Understand the concepts of error handling ,flow control ,IP Addressing and Routing.
3. Understand the concept of TCP and UDP protocols.
4. Develop several protocols foe web Applications

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	3	2	2	2	_	3	3		
CO2	1	1	1	1	1	1	3	3	2	3	1	_	1	
CO3	1	1	1	1	1	1	3	3	2	3	1	_		1
CO4	3	3	3	3	2	3	2	2	3	_	3	_		

ECMN18(EC604C-Program Elective-II)**- Cyber Security**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: The course deals with the underlying principles of cryptography and network security. It develops the mathematical tools required to understand the topic of cryptography. Starting from the classical ciphers to modern day ciphers, the course provides an extensive coverage of the techniques and methods needed for the proper functioning of the ciphers. The course deals with the construction and cryptanalysis of block ciphers, stream ciphers and hash functions. The course defines offers the construction and cryptanalysis of public key ciphers, namely RSA. The key exchange problem and solutions using the Diffie-Hellman algorithm are discussed. Message Authentication Codes (MAC) and signature schemes are also detailed. The course deals with modern trends in asymmetric key cryptography, namely using Elliptic Curves. The course ends with the awareness about different network attacks and precautions to be taken for the security.

Course Objectives:

1. To know the basics of Cryptography and Network Security.
2. To be able to secure a message over insecure channel by various means.
3. To learn about how to maintain the Confidentiality, Integrity and Availability of a data.
4. To have the knowledge of security requirements for a network against various threats.

Unit -I

Introduction: OSI Security Architecture - Classical Encryption techniques – Cipher Principles – Data Encryption Standard – Block Cipher Design Principles and Modes of Operation - Evaluation criteria for AES – AES Cipher – Triple DES – Placement of Encryption Function – Traffic Confidentiality

Unit –II

Public Key Cryptography Key Management - Diffie-Hellman key Exchange – Elliptic Curve Architecture and Cryptography - Introduction to Number Theory – Confidentiality using Symmetric Encryption – Public Key Cryptography and RSA.

Unit -III

Authentication And Hash Function: Authentication requirements – Authentication functions – Message Authentication Codes – Hash Functions – Security of Hash Functions and MACs – MD5 message Digest algorithm - Secure Hash Algorithm – RIPEMD – HMAC Digital Signatures – Authentication Protocols – Digital Signature Standard.

Unit -IV

Network Security Authentication Applications: Kerberos – X.509 Authentication Service – Electronic Mail Security – PGP – S/MIME - IP Security – Web Security.

Unit –V

System Level Security Intrusion detection – password management – Viruses and related Threats – Virus Counter measures – Firewall Design Principles – Trusted Systems.

TextBook:

1. William Stallings, "Cryptography And Network Security – Principles and Practices", Prentice Hall of India, Third Edition, 2003.

References:

1. Atul Kahate, "Cryptography and Network Security", Tata McGraw-Hill, 2003.
2. Bruce Schneier, "Applied Cryptography", John Wiley & Sons Inc, 2001.
3. Charles B. Pfleeger, Shari Lawrence Pfleeger, "Security in Computing", Third Edition, Pearson Education.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1.Understand different encryption techniques
2. Implement basic security algorithms required by any computing system
3. Analyze the vulnerabilities in any computing system to design a security solution
4. Analyze the possible security attacks and their effective countermeasures in real time systems

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	1	1	-	-	-	-	2	-	-	-
CO2	3	3	3	2	1	2	-	-	-	-	2	-	-	-
CO3	3	3	2	3	2	2	-	-	-	-	3	3	3	3
CO4	3	3	3	2	2	2	-	-	-	-	3	3	3	3