SRI VENKATESWARA UNIVRSITY:: TIRUPATI
DEPATMENT OF ENVIRONMENTAL SCIENCE

1.1.2. Minutes of the Board of Studies Meeting.

Venue: HOD Chamber **Date: 15-10-2020** **Time: 11.30 AM**

Members present:

S.No	Name of the Faculty Member	Designation
1.	Prof. C. Suresh Reddy	BOS Chairman
2.	Prof. T. Damodharam	HODEnvironmental Science

Resolutions:

1. The M.Sc., Environmental Science programme syllabus is not changed for the Academic Year 2020-21 and it is continued as it is.

Signatures:

S.No	Name of the Faculty Member	Signature
1.	Prof. C. Suresh Reddy	
2.	Prof. T. Damodharam	

2020-2021

Programme Code	Programme name	Year of Introduction	Status of implementation of CBCS/Elective Course System (ECS)	Year of implementation of CBCS/ECS	Year of revision (ifany)	If revision has been carried out in the syllabus duringthelast5 years, Percentage of Content added or replaced	Link to the relevant documents
254	M,Sc., Environmental Science	1997	CBCS: 2020-21 ECS:Yes	CBCS: 2020-21 ECS:Yes	CBCS: 2020-21 ECS:Yes	**2020-21** (2 Papers Replaced. 306 B in 405 C)	Copy Enclosed

S.V. UNIVERSITY, TIRUPATI

DEPARTMENT OF ENVIRONMENTAL SCIENCES

COURSE STRUCTURE

SYLLABUS

Choice Based Credit System (CBCS)

2020-2021

DEPARTMENT OF ENVIRONMENTAL SCIENCES

VISION

- To be the Nation's premier in research and development in Environmental Sciences.
- The Department will be multidisciplinary in its approach and responsiveto currentenvironmental issues Air pollution, water pollution and global warming.
- Environmental Sciences is to contribute quality instruction and scientific expertise in the geosciences, both now and for the future, to meeting global challenges in supplies of natural resources.
- To reduce environmental pollution, developing agriculture without soil contamination, preserving aesthetic values, mitigation of natural hazards, protection of the environment and public awareness of science.

MISSION

- Relevant and innovative information and communication to aid in sustainable development, management and decision making involving increasingly stressed land and water supplies.
- Technical expertise for addressing critical zone and environmental issues(including contaminant remediation, sustainable food production, soil and water quality) in rural and urban centers and the rapidly changing interfaces between them.

Course Description: Ecology and Environment, Environmental Chemistry, Environmental Toxicology and Public Health, Human Values and Professional Ethics, Energy and Environment, Environmental Pollution, Instrumental Techniques and Applications, Waste Treatment and Management, Environmental Impact Assessment, Audit And Economics, Statistics, Computer Applications and Modeling, Natural Resources Conservation, Water Resources and Watershed Management, Remote Sensing and GIS, Environmental Laws, Policies and Legislation Forest Resources and Management.

SVU COLLEGE OF SCIENCES

CHOICE BASED CREDIT SYSTEM (CBCS) (AS PER NEW UGC REGULATIONS)

The course of Study and Scheme of Examinations(With Effect from 2020-21)

M.SC. ENVIRONMENTAL SCIENCES

SEMESTER - I

S.No	Course Code	Components of Study	Title of the Paper	Contact hours	No. of Credits	I A Marks	End SEM Exam Marks	Total
1	ENV 101	Core- Theory	Ecology and Environment	6	4	20	80	100
2	ENV 102	Core- Theory	Environmental Chemistry	6	4	20	80	100
3	ENV 103	Core-Practical I	Practical - I	6	4	-	-	100
4	ENV 104	Core-Practical II	Practical - II	6	4	-	-	100
5	ENV 105	Compulsory Foundation **(Related to Subject)**	Environmental Toxicology and Public Health	6	4	20	80	100
6	ENV 106	Elective Foundation **(Human Values and Ethics)**	Human Values and Professional Ethics	6	4	20	80	100
		Total		**36**	**24**			**600**

SEMESTER-II

S.No	Course Code	Components of Study	Title of the Paper	Contact hours	No. of Credits	I A Marks	End SEM Exam Marks	Total
1	ENV 201	Core- Theory	Energy and Environment	6	4	20	80	100
2	ENV 202	Core- Theory	Environmental Pollution	6	4	20	80	100
3	ENV 203	Core-Practical I	Practical - I	6	4	-	-	100
4	ENV 204	Core-Practical II	Practical - II	6	4	-	-	100
5	ENV 205	Compulsory Foundation **(Related to Subject)**	Instrumental Techniques and Applications	6	4	20	80	100
6	ENV 206	Elective Foundation **(Human Values and Ethics)**	Human Values and Professional Ethics	6	4	20	80	100
		Total		**36**	**24**			**600**

SEMESTER-III

S.No	Course Code	Components of Study	Title of the Paper	Contact hours	No. of Credits	I A Marks	End SEM Exam Marks	Total
1	ENV 301	Core- Theory	Waste Treatment and Management	6	4	20	80	100
2	ENV 302	Core- Theory	Environmental Impact Assessment, Audit And Economics	6	4	20	80	100
3	ENV 303	Core- Practical I	Practical - I	6	4	-	-	100
4	ENV 304	Core- Practical II	Practical - II	6	4	-	-	100
5	ENV 305	Generic Elective* **(Related to Subject)**	(a) Ecotourism and Eco-Restoration (b) Biodiversity Conservation and Management (c) Statistics, Computer Applications and Modeling	6	4	20	80	100
6	ENV 306	Open Elective* (**For other Department)**	(a) Natural Resources Conservation (b) Global Environmental Issues	6	4	20	80	100
		Total		**36**	**24**			**600**

*** A Student is allowed to take i) one generic elective and one open elective or ii) two generic electives, to secure the minimum number of credits.**

SEMESTER-IV

S.No	Course Code	Components of Study	Title of the Paper	Contact hours	No. of Credits	I A Marks	End SEM Exam Marks	Total
1	ENV 401	Core- Theory	Water Resources and Watershed Management	6	4	20	80	100
2	ENV 402	Core- Theory	Remote Sensing and GIS	6	4	20	80	100
3	ENV 403	Core- Practical I	Practical - I	6	4	-	-	100
4	ENV 404	Core- Practical II/ Project Work	Project Work + Comprehensive Viva-Voce	6	4	-	-	100
5	ENV 405	Generic Elective* **(Related to Subject)**	(a) Disaster Mitigation and Management (b) Environmental Laws, Policies and Legislation (c) Environmental Management and Sustainable Development	6	4	20	80	100
6	ENV 406	Open Elective* (**For other Department)**	(a) Forest Resources and Management (b) Environmental Education	6	4	20	80	100
		Total		**36**	**24**			**600**

*** A Student is allowed to take i) one generic elective and one open elective or ii) two generic electives, to secure the minimum number of credits.**

SVU COLLEGE OF SCIENCES : TIRUPATI

DEPARTMENT OF ENVIRONMENTAL SCIENCES

CHOICE BASED CREDIT SYSTEM (CBCS)

(For Regular students, S.V.U. Colleges (Campus), Tirupati
(w.e.f. academic year **2020-21**)

M.SC. ENVIRONMENTAL SCIENCE

SEM	COURSE CODE	TITLE OF THE COURSE	Contact Hours	No. of Credits	IA	ESE End Sem Exams	Total Marks
I	ENV 101	ECOLOGY AND ENVIRONMENT	6	4	20	80	100
	ENV 102	ENVIRONMENTAL CHEMISTRY	6	4	20	80	100
	ENV 103	PRACTICAL – I	6	4	-	-	100
	ENV 104	PRACTICAL – II	6	4	-	-	100
	ENV 105	Environmental Toxicology and Public Health **(Compulsory Foundation Related to subject)**	6	4	20	80	100
	ENV 106	Human Values and Professional Ethics – I **(Elective Foundation related to Human values and ethics)**	6	4	20	80	100
II	ENV 201	Energy and Environment	6	4	20	80	100
	ENV 202	ENVIRONMENTAL POLLUTION	6	4	20	80	100
	ENV 203	PRACTICAL – I	6	4	-	-	100
	ENV 204	PRACTICAL – II	6	4	-	-	100
	ENV 205	Instrumental Techniques and applications **(Compulsory Foundation Related to subject)**	6	4	20	80	100
	ENV 206	Human Values and Professional Ethics – II **(Elective Foundation related to Human values and ethics)**	6	4	20	80	100
III	ENV 301	WASTE TREATMENT AND MANAGEMENT	6	4	20	80	100
	ENV 302	ENVIRONMENTAL IMPACT ASSESSMENT, AUDIT AND ECONOMICS	6	4	20	80	100
	ENV 303	PRACTICAL – I	6	4	-	-	100
	ENV 304	PRACTICAL – II	6	4	-	-	100
	ENV 305	a. Ecotourism and Eco- Restoration b. Biodiversity conservation and Management c. Statistics, Computer Applications and Modeling **(General Elective related to subject*)**	6	4	20	80	100
	ENV 306	a. Natural resources conservation. b. Global Environmental Issues **(Open Elective for other departments*)**	6	4	20	80	100

IV	ENV 401	WATER RESOURCES AND WATERSHED MANAGEMENT	6	4	20	80	100
	ENV 402	REMOTE SENSING AND GIS	6	4	20	80	100
	ENV 403	PRACTICAL – I	6	4	-	-	100
	ENV 404	PROJECT WORK + COMPREHENSIVE VIVA-VOCE	6	4	-	-	100
	ENV 405	a. Disaster Mitigation and Management b. Environmental Laws, Policies and Legislation a. Environmental Management and Sustainable Development **(General Elective related to subject)**	6	4	20	80	100
	ENV 406	b. Forest Resources and Management c. Environmental Education **(Open Elective for other departments*)**	6	4	20	80	100

***A Student is allowed to take i) one generic elective and one open elective or ii) two generic electives, to secure the minimum number of credits**

SEMESTER - I

ENV 101::ECOLOGY AND ENVIRONMENT

Course Objectives

- **To impart the knowledge on ecology and structure and functions of ecosystems.**
- **To inculcate ethics and learning in ecosystem imbalance, health and environment.**
- **To analyze soil profile and its importance of ecological balance.**
- **To estimate the nutrients in the different soil samples.**

UNIT-I

Ecology and Environment: Scope – Ecological Principles- Structure and Functions of Ecology- Ecological Factors-Environmental Science as interdisciplinary Subject – Earth, Man and Environment Relationship – Importance of biological cycles in the environment

UNIT-II

Population and Community Ecology: Population density- Population fluctuations-Population dynamics – Impact on Environment – Human population – Effect on Environment – Growth and factors affecting change in size of human population – Family Planning Methods, birth control, socio-economic methods of controlling population growth- Seed Germination and Reproductive capacity

Different communities and their occupation in different ranges in the environment and their relationship for the maintenance of eco-balance in the environment

UNIT – III

Ecosystem – Definition – Components – Structure – Types – Functions – Interrelationship of different ecosystems – Food chain – Food web – Productivity – Ecological energetics – Energy flow in the ecosystem-Ecological efficiency-Ecological Concepts of the Species- Habitat and Niche, ecological succession.

UNIT – IV

Soil Nutrients – Soil profile – Soil texture – Soil classification– Soil organic matter –Soil microbes– Biogeochemical cycles (C, N, P, K) – Ecological aspects and their importance for maintenance of eco-balance – Food production and future human existence in the environment – Eco-friendly programmes.

REFERENCES:

1. Odum E.P., **Fundamentals of Ecology,** WB Saunders Co., London (1971).
2. Sharma P.D., **Ecology and Environment,** Rastogi Publications, Meerut (1994).
3. Oliver S Owen, **Natural Resources Conservation – An Ecological Approach**, acmillan Publishing Co. Inc., New York (1980).
4. Daniel D Chiras, **Environmental Science,** the Benjamin/Cummings Publishing Co. Inc (1994).
5. Singh H.R., **Introduction to Animal and Environmental Biology,** Vishal Publications (1989).
6. Robert H Giler, **Wildlife Management,** W.H. Freeman and Company, San Francisco (1978).
7. Raymond F Dasmann, **Environmental Conservation**, John Wiley & Sons (1984).
8. N.S. Subrahmanyam, A.V.S.S Sambamurty, **Ecology,** Narosa Publishing House, New Delhi.

Course Outcomes

- **Provide solutions to environmental problems using appropriate tools and techniques.**

- **Develop both a quantitative and qualitative understanding of interactions between organisms and their consequences.**
- **Gain the knowledge of functions of organisms and ecosystem.**
- **Describe programmes environmental protection by implementing eco-friendly for human existence.**

CO-PO Mapping

CO outcomes	PO_1 Knowledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team Work	PO_{10} Communi-cation	PO_{11} Programme Management	PO_{12} Lifelong Learning
CO1	3	2		3		2	3					3
CO2	3	3				3	3					3
CO3	3			3		3	3				3	3
CO4	2					3		3				3

ENV 102::ENVIRONMENTAL CHEMISTRY

Course Objectives

- **To understand emissions and distribution of the air pollutants and particles in the atmosphere.**
- **To identify chemical properties and reactions of the compounds in the air.**
- **To understand the primary and secondary pollutants and its effects.**
- **To inculcate non polluted environment using green chemistry.**

UNIT – I

Atmospheric Chemistry: Chemical reactions in the atmosphere – Aerosol types, production and distribution – Aerosols and radiation – Atmospheric turbidity and related environmental problems - Inversions – Global climate and photochemical reactions – Global warming – Greenhouse effect – Ozone depletion – Acid rain – Corrosion mechanism – Prevention – Particles in Atmosphere – Composition sources – Types and effects.

UNIT – II

Toxicological Chemistry: Introduction to toxicology and toxicological Chemistry – Toxicants – Dose-Response Relationships – Reactions of acids and bases on surfaces - Toxic chemicals in the environment – Biochemical aspects of As, Cd, Pb, Hg, CO, O_3, PAN, Pesticides, MIC and carcinogens in air.

Biotransformation of Xenobiotics: Principles – Receptor sites – absorption and storage of xenobiotics – types of biotransformations – Microsomal oxidations – Mixed function oxygenizes – conjugation – biotransformation of organochlorine and organophosphorous pesticides – Antidotal procedures in Toxicology.

UNIT – III

Soil Chemistry: Micro and Macronutrients – Inorganic and Organic contaminants in the soil – Biodegradation – Nondegradable waste and its effect on the environment –Bioremediation of surface soils – Fate and Transports of contaminants in the Vadose zone – Bioindicators – Soil parameters – Soil destruction – Erosion – Soil conservation.

UNIT – IV

Water Chemistry: Water pollutants – Types – Sources – Heavy metals – Metalloids – Organic, Inorganic, Biological and Radioactive – Types of reactions in various water bodies including marine environment – Eutrophication – Ground water – Potable water.

Green Chemistry: Introduction – Inception and Evolution – Importance of solvents – Types of catalysts and their role – Biological alternatives – Applications.

REFERENCES::

1. Sharma, B.K. Kaur H., **Environmental Chemistry**, Goel Publishing House (1995).
2. Tyagi O.D. and Mehra M, **Text Book of Environmental Chemistry,**Anmol Publications (1990).
3. Johnson D.O., Netterville J.T., Wood J.C. and James M, **Chemistry and the Environment***,*W.B.Saunders Company Philadelphia (1972).
4. Bailey R.A., Clerke H.M., Ferris J.P., Krause S and Strong R.L., **Chemistry of the Environment,** Academic Press., New York (1978).
5. Stanley E Manahan, **Environmental Chemistry,** Lewis Publishers (2001).
6. Thomas G Spiro and William M Stigliani, **Chemistry of the Environment,**Prentice Hall of India (2004).
7. RashmiSanghi and Srivastava M.M., **Green Chemistry,** Narosa (2006).

Course outcomes

- **Demonstrate knowledge of chemical and biochemical principles of fundamental environmental processes in air, water and soil.**
- **Apply basic chemical concepts to analyze chemical processes involved in different environmental problems.**
- **By knowing pollution levels in the environment best possible fresh environment can be created in different methods like afforestation, natural parks and sanctuaries etc., for human concern.**
- **Acquire the knowledge to implementation of biological alternatives for protection of the environment.**

CO outcomes	PO_1 Knowledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team Work	PO_{10} Communi-cation	PO_{11} Programme Management	PO_{12} Lifelong Learning
CO1	3	2		3	3	2	3		2			3
CO2	3	3				3	3					3
CO3	3			3		3	3				3	3
CO4	2					3		3				3

ENV103:: PRACTICAL – I

Course objectives

- **To estimate population of flora and fauna in the ecosystem.**
- **To examine nutrients levels in various samples of wastewater.**
- **To estimate the protein, carbohydrates and nucleic acid in the different species.**
- **To examine the natural condition for species survival.**

1. Estimation of effective population size.
2. Estimation of Species Diversity.
3. Estimation of a primary production in a water body.
4. Estimation of dust accumulated on plant parts and its effects on morphology and anatomy of plants.
5. Estimation of protein content of biological samples.
6. Determination of total carbohydrates in biological system.
7. Estimation of trace heavy metals in soil, plant and animal material.
8. Estimation of sulphates, phosphates, nitrates and chlorides in water sample.

Course outcomes

- **Imparting practical knowledge about estimation of pH, Total Dissolved Solids, Hardness and Dissolved Oxygen, Chlorides and Sulphates in water samples.**
- **Imparting practical knowledge about estimation of pH, Total Dissolved Solids, Hardness and Dissolved Oxygen, Chlorides and Sulphates in water samples.**
- **Understand the environmental changes due to pollution levels.**
- **Examine the various ecosystems and its biodiversity.**

ENV104:: PRACTICAL – II

Course objectives

1. **To examine the contamination of the environment with chemical load by spectroscopic technology.**
2. **To analyze the concentration of the metals in the environment.**
3. **To inculcate the knowledge in scientific instrumentation.**
4. **To understand applications of organic matter in soils.**
5. Determination of chromium and zinc by Spectrophotometry.
6. Multi element analysis by AAS.
7. Analysis of mercury by mercury analyzer.
8. Application of Fluorimetry.
9. Estimation of Na, K, Ca, Mg by Flame Photometry.
10. Determination of soil type and texture, pH, Hydraulic conductivity, Soil moisture, Nitrogen, Potassium, Phosphorous and Organic matter.
11. Determination of Fe^{+2}/Cr^{+6} in soil sample.

Course outcomes

- **Understanding of various alkalinities present in the water sample by volumetric titration linked with theory.**
- **By knowing water pollution potable water can be drawn out and wastewater can be treated.**

- **By knowing various experiments of minerals fertility of the soil can be known which is advantage to farmers for agriculture.**
- **Describe the advantages of organic forming.**

ENV 105 :: ENVIRONMENTAL TOXICOLOGY AND PUBLIC HEALTH

Course objectives

- **To introduce the applications of environmental toxicology in the context of public health.**
- **To focus on the fate of chemicals in our environment and routes of exposure.**
- **To understand the epidemic diseases and control methods.**
- **To impart the knowledge in understanding of biotechnology for degradation of waste products in the environment.**

UNIT - I

Environmental Degradation: Man and Environment – Man made Degradation – Deforestation – Urbanization – Industrialization – Mining – Dam building and other activities.

UNIT – II

Environmental Toxicology: Introduction of Toxicology – History and Types of Toxicology – Toxicity (LD^{50} and LC^{50}) – Hazards – Risk Benefits – Risk ratio to tolerance limits – Acceptable daily intake – Threshold Value – Pesticide Toxicology – Detoxification – Resistance and Metabolism – Pesticide – Pesticide Classification – Pest Surveillance – Pest resistance - Residue and Effect – Heavy Metal Toxicology – Toxicology of some Hydrocarbons – Industrial Toxicology and Risk Assessment.

UNIT – III

Environmental Epidemiology: Role of Epidemiological Study in evaluation of Environmental Hazards – Occupational Environmental and Health Hazards – Community Environment and Health Hazards – Microbial, Algal, Invertebrate and Alternative Toxicity Tests – Epidemiological Episodes.

UNIT - IV

Health and environmental impacts of Nanaotechnology :

Engineered Nanomaterials of Relevance to Human Health – Engineered Nanomaterials in the Body – Routes of Entry – Toxicological Health Effects Caused by Nanopartircles – Relevant Parameters in Nanoparticle Toxicology – Integrated Concept of Risk Assessment of Nanoparticles – Plant and Microbes as Nanofactories.

Public Health: Public Health Programmes – Objectives and Scope – Urban and rural Health – Sanitation – Malarial Control Measures – HIV/AIDS – Domestic and Residential Waste Disposal Studies.

REFERENCES:

1. Sharma.P.D.,**Environmental Biology and Toxicology,** Rastogy (1994).
2. MeeraAsthana and Asthana.D.K.,**Environmental Pollution And Toxicology,**Alka Printers (1994).
3. Guithinier Perry, **Introduction to Environmental Toxicology,** Elsevier Publications (1980).
4. Oehme W.F., **Toxicity of Heavy Metals in Environment,** Marcel Dakkar Inc., New York (1989).
5. Lave L.B. and Upton A.C., **Toxic Chemicals, Health and the Environment,** John Hopkins University Press, Baltimore and London (1987).

6. Beyar W.N., Heing H.G. and Norwood A.W.R., **Environmental Contaminants in Wild Life,** CRC Lewis Publishers, New York (1996).
7. Dikshit T.S.S., **Toxicology of Pesticide in Animals,** CRS Press Inc., Boca Raton, Florida, USA (1991).
8. SubbiahBalji**Nanobiotechnology,** MJP Publishers, Chennai(2010). (P.No.181 – 207).
9. Dr.U.Kumar, **NanoTechonology: Fundamental approach**, AgroBios, Jodhpur. (P.No.216 - 225)

Course outcomes

- **Understand the role of toxicants in environment and methods used to quantify toxicity.**
- **Inform, educate, and empower people about the potential hazards of toxic substances to environmental and human health.**
- **By knowing the adverse health problems on human beings, safety, preventing measures can be implemented endemic and pandemic diseased can be controlled.**
- **Understand the toxicity of pesticide, detoxification metals on public health.**

CO-PO Mapping

CO outcomes	PO_1 Knowledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team Work	PO_{10} Communi-cation	PO_{11} Programme Management	PO_{12} Lifelong Learning
CO1	3	2			3	2	2					3
CO2	3	3				3	3					3
CO3	3			3			3					3
CO4	2				2	3		3		2		3

ENV 106 :: HUMAN VALUES AND PROFESSIONAL ETHICS

Course objectives

- **To inculcate the knowledge on professional and ethical values.**
- **To understand classification of moral and ethical values in traditional texts.**
- **To describe enlightenment and social behavior towards the various religious and society.**
- **To create social values and professional ethics.**

UNIT –I:

Definition and Nature of Ethics – Its relation to Religion, Politics, Business, Legal, Medical and Environment. Need and Importance of Professional Ethics – Goals – Ethical Values in various Professions.

UNIT – II:

Nature of Values- Good and Bad, Ends and Means, Actual and potential Values, Objective and Subjective Values, Analysis of basic moral concepts- right, ought, duty, obiligation, justice, responsibility and freedom. Good behavior and respect for elders.

UNIT – III:

Ahimsa (Non-Violence), Satya (Truth), Brahmacharya (Celibacy), Asteya(Non-possession) and Aparigraha (Non-stealing). Purusharthas (Cardinal virtues)- Dharma (Righteousness), Artha (Wealth), Kama(Fulfilment Bodily Desires). Moksha (Liberation).

UNIT – IV:

Bhagavad Gita-(a) Niskama karma. (b) Buddhism- The Four Noble Truths – Arya Astangamarga, (C) Jainism – mahavratas and anuvratas. Values Embedded in Various Religions, Religious Tolerance, Gandhian Ethics.

UNIT – V:

Crime and Theories of punishment- (a) Reformative, Retributive and Deterrent . (b)Views on manu and Yajnavalkya.

REFERENCES:

1. R.Subramanian, Professional Ethics, Oxford University Press
2. John S Mackenjie: A Manual of ethics.
3. The Ethics of Management" by Larue Tone Hosmer. Richard D.Irwin Inc.
4. "Management Ethics" integrity at work' by Joseph A. Petrick and John F. Quinn. Response Books: New Delhi.
5. "Ethics in Management" by S.A. Sherlekar, Himalaya Publishing House.
6. Harold H. Titus: Ethics for Today.

Course outcomes

- **Describe the human values, understand the commitment and responsibility.**
- **They gain the ability to bring harmony to the society.**
- **By studying human values reformation of man and reformation of policy shall be done and harmony of environment and society also can be achieved.**
- **Moral code of conduct and social behavior towards religion and social harmony.**

CO-PO Mapping

CO outcomes	**PO_1 Knowledge**	**PO_2 Analysis**	**PO_3 Design**	**PO_4 Development**	**PO_5 Modern Tools**	**PO_6 Society**	**PO_7 Environment**	**PO_8 Ethics**	**PO_9 Team Work**	**PO_{10} Communi-cation**	**PO_{11} Programme Management**	**PO_{12} Lifelong Learning**

CO1	2			2	3	2		3				2
CO2	2			2		2	3	3				2
CO3	2							2				2
CO4	2				2	3		2		2		2

SEMESTER – II

ENV 201::ENERGY AND ENVIRONMENT

Course outcomes

- **To understand energy concepts for conventional and renewable energy technologies and their application.**
- **To provide energy production methods and consequent environmental impacts.**
- **To understand sources of various green energy and applications.**
- **To inculcate the bio-energy practices for maintain environmental quality.**

UNIT – I

Basic Concepts of Energy: Energy – Definition – Forms of energy – Potential, Kinetic, Mechanical, Thermal, Electrical, Chemical and Nuclear Energy – Uses of energy – Energy Sources – Conventional and Non-conventional energy sources.

Conventional Energy Sources: Firewood – Coal – Origin and development of coal – Coal reserves in India and World – Clean coal combustion – Petroleum and Natural Gas – Composition and Classification of Petroleum – Reserves of Petroleum and Natural Gas in India and the World – Hydroelectric Power – Thermal Power – Synthetic Fuels – Consumption and management of conventional energy sources.

UNIT - II

Alternate energy Sources: Need for alternate energy sources – Renewable energy sources.

Solar Energy: Importance – Collection of Thermal Energy – Flat Plate Collector – Solar Air Collector – Solar Concentrators – Thermal Energy Storage – Non-convective Solar Pond – Photovoltaic Systems.

UNIT – III

Wind Energy: Wind Energy Conversion System – Operational Characteristics – Applications of Wind Energy.

Geothermal Energy: Basics of Geological Process – Geothermal Resources – Utilization.

Ocean Tidal and Wave Energy: Introduction – Energy Conversion Systems.

Bioenergy: Biomass, Biofuels and Biogas – Origin of Biomass – Biomass Sources – Biofuel Production Process – Gasification – Biogas.

Nuclear Energy: Need and importance – Sources of nuclear energy – Nuclear fission reactions – Fission Power – Fusion Power.

UNIT – IV

Environmental Effects associated with Energy Sources and Energy Planning: Energy Consumption in India and different parts of the World – Environmental Impact of large scale exploitation of solar, wind, hydro and ocean energy – Energy Planning and Legislation – Future Energy Options – Indo-US Nuclear Agreement.

REFERENCES::

1. Tiwari G.N. and Ghosal M.K., **Renewable Energy Resources,** Narosa (2005).
2. Rai G.D., **Non-conventional Energy Sources,** Khanna Publishers (2001).
3. Desai A.V., **Bio energy,** Wiley Eastern Limited, International Development Research Center, Ottawa, Canada.

4. Trivedi R.P. and Gurudeep Raj, **Encyclopedia of Environmental Sciences – Environmental Energy Resources.**
5. Sukhatme S.P., **Solar Energy,** Tata McGraw Hill, New Delhi (1996).

Course outcomes

- **Explain the key challenges and technologies in energy use, utilization of energy resources, energy conversion and environmental consequences.**
- **They explain basic competence regarding environmental impacts arising from different energy carriers and technical solutions.**
- **Enrichment of ecosystem will be achieved.**
- **Explain energy planning for future generations.**

CO-PO Mapping

CO outcomes	PO_1 Knowledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team Work	PO_{10} Communi-cation	PO_{11} Programme Management	PO_{12} Lifelong Learning
CO1	2		2	2	3	2	2		1		2	3
CO2	2		2	2	2	2	3		1		2	2
CO3	2	2	2	3	2	3	3		2			3
CO4	2		2	2	2	3	2		2	2	2	2

ENV 202:: ENVIRONMENTAL POLLUTION

Course objectives

- **To understand route way of pollutants and their impacts on the environment.**
- **To impart the knowledge on diseases caused by pollution.**
- **To understand classification of pollution, predictions and consequences of society.**
- **To understand safe disposal of radioactive wastes.**

UNIT – I

Atmospheric Pollution: Sampling and analysis of SO_2, NO_X, NO_2, CO_2, fluoride, hydrocarbons and particulates – Cryogenic sampling – Impinges – Scrubbers – Adsorption – Absorption for analysis of SO_2, NO_2, CO_2, fluoride and hydrocarbons – Automobile emissions – Types and their control methods – Auto cyclic engines – Gaseous pollutant monitoring – Particulate – Ringleman Scale – Dosimetry – High volume samples – Analysis and control of particulate matter.

Indoor Air Pollution: Sources – Classification – Respirable particulates – Radon and biological contaminants – Analysis and design.

UNIT – II

Water Pollution: Sampling, analysis and prevention – Determination of pH, DO, BOD, COD, Solids, colour, turbidity, various forms nitrogen, phosphates, fluorides, sulphates, hardness, heavy metals, oil and grease, phenols, pesticides and radio nuclides.

UNIT – III

Soil Pollution: Sampling, analysis and prevention – Determination of pH – Cation exchange capacity of macro and micronutrients in soil systems.

Marine Pollution: Marine – Material addition – Natural and Anthropogenic activity – Oil pollution and effects on marine organisms – Control methods.

UNIT – IV

Noise Pollution: Sources – Noise indices – Classification of Noise loads – Effect of noise on biota and human health – Control and prevention methods.

Radioactive Pollution: Sources of Pollution – Effect of radiation on environment –Safe disposal of radioactive waste – Radiation protection and control measures – Biological dosimetry.
Thermal Pollution: Sources – Various chemical and biological reactions of water – Prevention and Control of thermal pollution.

REFERENCES:

1. Henry C Perkins, **Air Pollution,** McGraw-Hill (1974).
2. Chhatwal G.R, Mehra M.O., Katyal T, Satake K Mohan Katyal and Nagahiro T, **Environmental Noise Pollution and its Control**, Anmol Publications (1989).
3. Trivedy R.K. and Goel P.K., **An Introduction to Air Pollution**, Techno Science Publications, Jaipur (1995*).*
4. Kudesia V.P., Water **Pollution,**PragatiPrakashan Publications (1985).
5. Sharma P.D., **Environmental Biology,** Rastogi and Co (1995).
6. Harrison, R.M., **Pollution – Causes, Effects and Control,** Royal Society of Chemistry (1990).
7. Handbook of Nanofabrication. Edited by Gary W iederrcht.Elsevier, 2010.
8. Introduction to Nanoscience by Gabor L. Hornyak, Joydeep Dutta, Harry F. Tibbals, Anil K. Rao. CRC Press, 2008.

Course outcomes

- **Analyze sources of pollution, exposure pathways, fate and evaluate consequences of human exposure to pollution and its impacts to environmental quality.**
- **Distinguish the effect of pollutants on human health, economy and wild environments.**
- **Pollution free environment for human life will be achieved.**
- **Explain the contamination of water bodies due to discharge of untreated wastewater into the drain.**

CO-PO Mapping

CO outcomes	PO_1 Knowledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team Work	PO_{10} Communi-cation	PO_{11} Programme Management	PO_{12} Lifelong Learning
CO1	3	2	1	2	3	2	2					2
CO2	2	2	2	2	2	2	3	1			2	2
CO3	2	2		2	2	2	3					3
CO4	2	2	2	2	2	2	2		2	2	2	2

ENV 203:: PRACTICAL – I

Course objectives

- **To analyze wastewater and pond water samples.**
- **To estimate the concentration of various metals is environment.**
- **To analysis of toxicants in environmental samples.**
- **To understand bioaccumulation of pesticides.**

1. Determination of pH, Dissolved solids and suspended solids, Dissolved Oxygen, COD, BOD, Alkalinity/Acidity and hardness.
2. Production of biogas in laboratory.
3. Photovoltaic applications of solar cell.
4. Determination of the amount of pesticide/insecticide in water/vegetable samples.
5. Estimation of biochemical toxicity by AAS.
6. Estimation of the amount of NO_2 in photochemical smog samples.

Course outcomes

- **Describe the amount of pesticide/insecticide in water/vegetable samples.**
- **Report the values of analyzed inferences of the experiments.**
- **Assess the concentrations of pollutants.**
- **Explain the formation of photochemicals.**

ENV 204:: PRACTICAL – II

Course objectives

- **To understand the difference of LC_{50} and LD_{50}.**
- **To evaluate the samples like water, soil and biological.**
- **To examine the growth rate of fauna in different habitats.**
- **To assess micro and macro nutrients in the soil samples.**

1. Estimation of the amount of LC_{50} of Pb in organisms.
2. Vegetation analysis: Frequency, Abundance and Density, Cover and Basal area, Important Value Index.
3. Vegetation sampling: Transects, Plot less methods.
4. Community coefficients.
5. Diversity measures: Shannon Wiener, Simpson and Brillion's Index.
6. Diversity measures of Birds fauna in different habitat conditions.

Course outcomes

- **Identify the concentration of biochemical by using instrumental methods.**
- **Applications of scientific methods for analysis of pollution.**
- **Applications of basic scientific principle in the evaluation of pollution by instruments.**

ENV 205: INSTRUMENTAL TECHNIQUES AND APPLICATIONS

Course objectives

- **To impart the knowledge in instrumental techniques.**
- **To understand in the operation and care of instruments used in the chemical laboratories.**
- **To inculcate chromatographics in plant pigments.**
- **To understand value of nanotechnology.**

UNIT – I

Spectroscopic Techniques: Basic principles – Beer-Lambert's Law – Salient features – Instrumentation and applications of UV-VIS Spectrophotometry – Colorimetry – Flame Photometry – Fluorimetry – Types of spectrophotometers – Use of spectroscopic techniques for trace metal analysis in environmental samples.

UNIT – II

Atomic Absorption and Emission Spectroscopy: Fundamentals of Atomic Emission and Atomic Absorption – Flame Atomic and Emission Spectroscopy – Atomic Absorption Spectrophotometer (AAS) – Principle and Instrumentation – Graphite Furnace – Flow Injection Technique – Inductively Coupled Plasma Emission Spectroscopy (ICPES) – Comparison of AAS and ICPES – Application of the AAS and ICPES for the determination of trace metals.

UNIT – III

Chromatographic Techniques: Basic principles – Paper Chromatography – Thin Layer Chromatography – Ion Exchange Chromatography – Higher Performance Liquid Chromatography – Gas Chromatography – Instrumentation and applications.

UNIT – IV

Radiochemical Techniques: Radioactivity – Carbon dating – Radioactive labeling – Tracer applications: Isotope Dilution, Neutron Activation Analysis – Radiometric Titration.

Nanomaterials for Environmental Protection: Nano technology processes – Nano Engineering materials for Pollution Prevention, Energy efficient resources and materials, Nano technology products- Nanomaterials, Nano devices and nanosystems

REFERENCES::

1. Willard, Merritt, Dean and Settle, **Instrumental Methods of Analysis,** CBS Publishers, New Delhi (1986).
2. Gurudeep R Chatwal and Sham K Anand, **Instrumental Methods of Chemical Analysis,** Himalaya (2005).
3. Vogel, **Text Book of Quantitative Inorganic Analysis,** Longmann Scientific and Technical, UK (1991).
4. Sharma B.K., **Instrumental Methods of Chemical Analysis,** Goel (2001).
5. **Standard Methods for the Examination of Water and Waste Water,** APHA, Washington (1998).
6. Murugesan and Rajakumari, **Environmental Science and Biotechnology – Theory and Practice,** MJP Publishers, New Delhi (2005)
7. Mao Hong fan, Chin pao Huang, Alan E Bland, Z Honglin Wang, RachidSliman, Ian Wright, **Environanotechnology**, Elsevier,(2010)
8. Jo Anne Shatkin, **Nanotechnology: Health and Environmental risk** , CRC press,(2008)

Course outcomes

- **Integrate a fundamental understanding of the underlining physics principles as they relate to specific instrumentation used for atomic, molecular, and mass spectrometry, magnetic resonance spectrometry and chromatography.**
- **Environmental potentiality will be achieved. This is indirect benefits to the society.**
- **Understand the analysis and level of concentration of different metals through instrumental techniques.**
- **Explain Nanotechnology and Nano Engineering and Nano Science.**

CO-PO Mapping

CO outcomes	PO_1 Knowledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team Work	PO_{10} Communi-cation	PO_{11} Programme Management	PO_{12} Lifelong Learning
CO1	3	2		1	2	2	1					1
CO2	3	2		2	2	2	1					1
CO3	2	2		2	1		3					3
CO4	2	2		2		2	2					2

ENV 206:: HUMAN VALUES AND PROFESSIONAL ETHICS – II

Course objectives

- **To create an awareness on professional ethics and Human Values.**
- **To appreciate the rights of others.**
- **To understand environmental ethics.**
- **To create an awareness on social ethics.**

UNIT – I:

Value Education- Definition – relevance to present day – Concept of Human Values – Self introspection – Self-esteem – Family values-Components, structure and responsibilities of family- Neutralization of anger – Adjustability – Threats of family life – Status of women in family and society – Caring for needy and elderly – Time allotment for sharing ideas and concerns.

UNIT – II:

Medical ethics- Views of Charaka, Sushruta and Hippocratus on moral responsibility of medical practitioners. Code of ethics for medical and healthcare professionals. Euthanasia, Ethical issues in relation to health care professionals and patients. Social justice in health care, human cloning, problems of abortion. Ethical issues in genetics engineering and Ethical issues raised by new biological technology or knowledge.

UNIT – III:

Business ethics- Ethical standards of business- Immoral and illegal practices and their solutions. Characterics of ethical problems in management, ethical theories, causes of unethical behavior, ethical abuses and work ethics.

UNIT – IV:

Environmental ethics- Ethical theory, man and nature- Ecological crisis, Pest control, Pollution and waste, Climate change, Energy and population, Justice and environmental health.

UNIT – V:

Social ethics- Organ trade. Human trafficking. Human Rights violation and social disparities, Feminist ethics. Surrogacy/Pregnancy. Ethics of media- Impact of Newspapers, Television, Movies and Internet.

REFERENCES:

1. John S Mackenjie: A manual of ethics
2. "The Ethics of Management" by Larue Tone Hosmer. Richard D. Irwin Inc.
3. "Management Ethics" integrity at work' by Joseph A. Petrick and John F. Quinn Response Books: New Delhi.
4. "Ethics in Management" by S.A. Sherlekar, Himalaya Publishing House.
5. Harold H. Titus: Ethics for Today
6. Maitra, S.K: Hindu Ethics
7. William Lilly: Introduction to Ethics
8. Sinha: A Manual of Ethics
9. Manu: Manava Dharma Sastra or the Institute of Manu: Comprising the Indian System of Duties: Religious and Civil (ed.) G.C.Halighton.
10. SusrptaSamhita:Tr.KavirajKunjanlal, KunjanlalBrishagratha. Chowkarnba Sanskrit series. Vol LII and III, Varanasi, Vol I 00, 16, 20, 21 – 32 and 74 – 77 only.
11. CharakaSamhita: Tr. Dr. Ram Karan Sarma and Vaidya Bhagavan Dash, Chowkambha Sanskrit Series office. Varanasi I, II, III Vol IPP 183-191.
12. Ethics, Theory and Contemporary Issues. Barbara Mackinnon Wadsworth/Thomson Learning, 2001.
13. Analyzing Moral. Issues, Judith A. Boss. May Field Publishing Company – 1999.
14. An Introduction to Applied Ethics (Ed.) John H.Piet and Ayodhya Prasad. Cosmo Publications.
15. Text Book for Intermediate First Year Ethics and Human Values. Board of Intermediate Education- Telugu – Academi, Hyderabad.
16. I.C Sharma Ethical Philosophy of India. Nagin& co Julundhar.

Course outcomes

- **Understand the core values that shape the ethical behaviour.**
- **An ability to apply their broad education towards the understanding of the impact of engineering solutions in a global and societal context.**
- **Making the students to full man, understanding the ethical values.**
- **Ability to achieve ethics in medical, business, environment and social.**

CO-PO Mapping

CO outcomes	**PO_1 Knowledge**	**PO_2 Analysis**	**PO_3 Design**	**PO_4 Development**	**PO_5 Modern Tools**	**PO_6 Society**	**PO_7 Environment**	**PO_8 Ethics**	**PO_9 Team Work**	**PO_{10} Communi-cation**	**PO_{11} Programme Management**	**PO_{12} Lifelong Learning**

CO1	3			2		2	1	3				1
CO2	2			2		2	1	3				2
CO3	1			1	2			2				2
CO4	2			2		3	2	2				2

SEMESTER – III

ENV 301:: WASTE TREATMENT AND MANAGEMENT

Course objectives

- **To understand purification practices for wastewater.**
- **To emphasize on design considerations of various unit operations and processes of water treatment facilities.**
- **To characterize the waste and apply the knowledge of laws for handling of various wastes and management.**
- **To understand the reduction of environmental pollution by recycling the waste products.**

UNIT – I

Water Treatment: Different sources of water – Methods of water purification – Flocculation, Sedimentation, Sedimentation with coagulation – Jar Test – mixing basins – Clarifiers – Filtration – Types of filtration – Disinfections of water – Industrial Waste water Treatment – Tannery, Distillery, Sugar mill, Paper mill and Pulp Industry – study of effluent treatment plants.- Miscellaneous methods, Desalination, Membrane techniques – Reclamation and reuse of industrial and domestic waste water – Rain water harvesting.

UNIT – II

Sewage Treatment and Disposal: Self purifications of streams – BOD and its importance – Treatment methods – Primary, Secondary and tertiary levels – Disinfections of treated sewage effluent – Septic tank design and effluent disposal methods – Disposal on land, Sewage sickness – Disposal by dilution – Design of biological treatment units – Sludge characteristics, unit operation in sludge disposal, conventional and high rate digester – Disposal of sludge – Gas utilization.

UNIT – III

Solid Waste Management: Sources and generation of solid waste – characterization, chemical composition and classification – Dumping of garbage – Commercial, Industrial Agriculture, Mining and Power Plant discharges – Disposal Methods – Composting, incineration and others – Biomedical waste management.

Hazardous Waste Management: Cyanides, Dioxins, detergents, plastics, nylon, PCB's and others – Waste minimization methods – Monitoring and management strategies – Chemical and disaster management and risk analysis – Degradation of pesticides, detergents, plastics and polymers.

Radio Active Waste: Sources – Radiation standards by ICRP – Other standards (AERB) –Low level and High level radioactive waste management –

UNIT – IV

Recycling of Wastes: Waste types – Sources – Waste generated per capita – Composition of wastes – Recycling of waste for Industrial, Agricultural and domestic purposes – Recycling of metal Products –

Reuse, Recovery – Reduction of paper, plastics etc., - Recycling of food manufacturing, beverages, apparel, leather, paper, pulp, chemical and other industries – Fly ash utilization.

REFERENCES:

1. Jerry A Nathanson, **Basic Environmental Technology,** Prentice Hall of India Pvt. Ltd. (2003).
2. Rao M.N. and Datta A.K., **Waste Water Treatment,** Oxford & IBH Publishing Company Pvt. Ltd. (1987).
3. Hammer M.J., **Water and Waste Water Technology,** John Willey (1986).
4. Garg S.K., **Sewage Disposal and Air Pollution Engineering,**Khanna Publications (1990).
5. Goel P.K., (ed), **Advances in Industrial Waste Water Treatment,**Techno Science Publications, Jaipur (1999).
6. Gilbert M Masters, **Introduction to Environmental Engineering and Science,** Prentice Hall of India Pvt. Ltd (1998).

Course Outcomes

- **Describe the components of solid waste management and the laws governing it.**
- **Discuss the solid waste collection systems, route optimization techniques and processing of solid wastes.**
- **Biodegradation of waste through natural and artificial methods will be achieved.**
- **Evaluating solid waste management practices in urban and rural environment.**
- **Explain minimize and reduce waste generation through applications of 3 R's policy.**

CO-PO Mapping

CO outcomes	PO_1 Knowledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team Work	PO_{10} Communi-cation	PO_{11} Programme Management	PO_{12} Lifelong Learning
CO1	3	2	3	2	2	2	3				2	3
CO2	3	2	2	2	2	2	3				2	3
CO3	3	3	2	2	2	3	3				2	3
CO4	3	2	2	2	3	3	3				2	3

ENV 302: ENVIRONMENTAL IMPACT ASSESSMENT, AUDIT AND ECONOMICS

Course objectives

- **To introduce and provide theoretical and practical education on environmental impact assessment.**
- **To assess the economic burden of environmental cause.**
- **To focus on the rationale and methodology of integrated environmental impact assessment (EIA) including consideration of the relevant bio-physical, social, cultural, economic and human health aspects of development proposals, programs and policies.**
- **To understand financial impact of environmental policy.**

UNIT – I

Environmental Impact Assessment: Definition – Purpose of EIA – Regulatory frame work in India – Base line data generation – Requiring and planning of field survey – Review of information required on development/industrial project – procedure for reviewing EI analysis and statement – EIA guidelines 1994 – Notification of Govt., of India – Identification of environmental risks due to developmental project activities – Preparation of on-site and off-site disaster management plans.

UNIT – II

Assessment Methodologies: Physical Environment Assessment – Flora Assessment – Plant Survey – Animal population size – Aquatic Assessment – Necessity of public participation in environmental decision making – Prediction and assessment of visual impacts of socio-economic environment.

Ecoplaning: Definition And concept – Land use policy for India – Urban and rural planning for India – Land use pattern – Cost benefit Analysis – Limits to Growth theory.

UNIT – III

Environmental Audit: Objectives – Scope – Coverage – Policy development – Defining boundaries – Goals – Policy compliance – Organization and staffing of Audit team – Resources – Approach to Audit ; (a) Pre-visit Activity (b) on-site activities – Understanding Management Systems – Assessing strengths and weaknesses – Audit evidence gathering and evaluation (c) Post Audit Activities – Audit principles – Benefits to Industry

UNIT – IV

Environmental Economics: Concepts of Economics and Scope of Environmental Economics – Economics of Pollution Control – Cost-Benefit Analysis and Evaluating Alternatives – Environmental Accounting – General Framework of Environmental Accounts.

REFERENCES:

1. Canter L.W., **Environmental Impact Assessment,** McGraw Hill Book Co, New York (1996).
2. Bregman J.L., **Environmental Impact Statements,** Lewis Publishers, London (1999).
3. Singleton R, Castle P and Sort D, **Environmental Assessment,** Thomas Telford Puiblishing, London (1999).
4. Eccleston C.H., **Environmental Impact Assessment – A comprehensive guide to project and strategic planning,** John Wiley and Sons (2000).
5. Murthi S, **Economic Growth and Environment,** RSBA Publishers (1998).

Course outcomes

- **Explain the concepts about the Environmental Impact Assessment (EIA) and describe the environment laws, aims and the necessity of EIA.**
- **Critically examine assumptions inherent in impact assessment, examine a range of environmental impact assessments and identify and explore impact assessment fields and approaches.**
- **Understand the sustainable development and controlling environmental pollution.**
- **Describe the environmental economics for sustainable development.**

CO-PO Mapping

CO outcomes	PO_1 Knowledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team Work	PO_{10} Communi-cation	PO_{11} Programme Management	PO_{12} Lifelong Learning

CO1	3	2		2	2	2	3				2	3
CO2	3	3	2	2	2	2	3				2	3
CO3	3	3		2		3	2				2	3
CO4	3	2		2	3	3	3				2	3

ENV 303:: PRACTICAL – I

Course objectives

- **To prepare EIA for project management and environmental statement for industries.**
- **To estimate the presence of sedimentary particles by scientific methods.**
- **To analyze environmental impact for will being of the society.**

1. Preparation of Activity-processes Flow Diagrams.
2. Case Study analysis for EIA of a major industry.
3. Case Study analysis for EIA of a Reservoir/Land Conversion/Mining activity.
4. Preparation of Environmental Statement.
5. Estimation of BOD content in industrial waste water.
6. Estimation of degradable products from pesticides.
7. Estimation of sedimentary particles by Jar Test.
8. Calculation of mean, meridian and mode

Course outcomes

- **Understand the degradation of natural resources by constructions of various projects.**
- **Understand requirement of oxygen for growth of organisms to break down organic matter in wastewaters.**
- **Describe the low cost wastewater treatment practices in water demand areas.**

ENV 304:: PRACTICAL – II

Course objectives

- **To construct practical statistical models for several processes in the real-world.**
- **To understand coefficient of two variable in samples.**
- **To understand the basic operations of a computer system.**

1. Calculation of correlation and regression.
2. Application of't' test.
3. Creation of DOS files.
4. MS-Word File: Creation, editing and retrieving.
5. MS-Power Point: Presentation Project preparation.
6. MS-Excel: Spreadsheet preparation.
7. E-mail and Internet.

Course outcomes

- **It helps to explain the relationships between variables of the real-world applications.**
- **Analyze evaluation of two variables.**
- **Develop the programming techniques and the problem solving skills through programming.**

ENV 305 (a) :: ECOTOURISM AND ECORESTORATION

Course objectives

- **To impart the knowledge in understanding the concepts of eco-tourism.**
- **To describe about the Eco-tourism and wildlife tourism in protected areas, planning and economics.**
- **To understand major sources of environmental degradation and its consequences on biodiversity.**
- **To understand soil fertility by adopting eco-restoration.**

UNIT - I

Concepts of Tourism: Classification – Religious Tourism – Cultural Tourism – Heritage Tourism – Monumental Tourism – Adventure Tourism – Sustainable Tourism – Consumptive and Non-consumptive Tourism – Origin of Ecotourism – Principles of Ecotourism – Types of Ecotourism – Concepts of Ecotourism – Objectives of Ecotourism – Benefits of Ecotourism.

UNIT – II

Study of Ecosystems: Places of interest of Ecotourism **–** Infrastructural facilities for Ecotourism – Maintenance of Ecological Centers – Important Biosphere Reserves – Ecotourism and Conservation – Study of different Ecosystems – Rain Forest Ecotourism – Mountain Ecotourism – Polar, Islands and Coasts Ecotourism.

UNIT - III

Impact of Ecotourism: Economic Impacts – Types and Degree of Impacts from Ecotourism activities – Socio-cultural Impacts – Ecotourism related organization – Trends affecting Ecotourism – Ecotourism Research – Disasters and Ecotourism.

UNIT – IV

Environmental Degradation: Major forms of Environmental Degradation – Causes and Consequences of Environmental Degradation.

Eco Restoration: Redressing of Ecological Poverty – Population Control – Attitudinal Changes – Rational Use of Resources – Restoring Soil Fertility, Soil Health – Optimum Use of Bio Resources – Eco Solutions.

REFERENCES

1. Weaver D.B., **The Encyclopedia of Ecotourism,** CABI Publishing, UK (2001).

2. Sinha P.C., **Encyclopedia of Ecotourism, Vol I, II and III,** Anmol Publications Pvt. Ltd., New Delhi (2003)

Course outcomes

- **Describe the challenging in eco-tourism and wildlife tourism.**
- **Understand values of wildlife and minimizing impact on natural ecosystem due to tourism.**
- **Rest and recreation to the public and income generation for the Government.**
- **Eco solutions will be achieved.**

CO-PO Mapping

CO outcomes	PO_1 Knowledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team Work	PO_{10} Communi-cation	PO_{11} Programme Management	PO_{12} Lifelong Learning
CO1	3		2	2	2	3	3					2
CO2	3					3	3					2
CO3	3					2						2
CO4	3	2										2

ENV 305 (b) :: BIODIVERSITY CONSERVATION AND MANAGEMENT

Course objectives

- **To assess biodiversity loss and the importance of biodiversity conservation.**
- **To emphasis regional diversity hotspots and important conservation areas.**
- **To develop biotechnological methods in pollution abatement and develop eco-friendly bio-products for environmental health.**
- **To acquire knowledge in environmental management through biological system.**

UNIT – I

Biodiversity: Definition and concept – Distribution of climatic regions of world and vegetation types – Patterns of species diversity – Species importance – Species area relationships – Theories of species diversity – Equilibrium theory – Biodiversity of tropical and temperate regions – Hot Spots of the world – Case Studies on Forests, Deserts, Coral Reef and Island Species.

UNIT – II

Measures of Biodiversity: Alfa, Beta and Gamma diversities – Indices of diversity and evenness – The Simpson Index Diversity of fully censured communities – Estimating the diversity of large community – Evenness and Equitability – Hierarchical diversity.

UNIT – III

Conservation and Management of Biodiversity: Types of conservation – In-situ and Ex-situ conservation – Concept of germ plasma preservation and gene banks – Community Biodiversity – Registers and their importance – National Biodiversity Strategy and Action Plan Programme – Protected Area Management Plan – Biodiversity Bill 2002 – Patent Act Agenda 21 – National Policies and Acts [Wild Life (Protection) Act,1972] related to biodiversity.

UNIT – IV

Environment and Biotechnology: Microbes in relation to environment – Biosensors – Environmental applications of biosensors – Biotechnological methods in pollution abatement – Biodegradation – Genetically Engineered Microbes (GEMs) in biotreatment of wastes – Eco-friendly bio-products for environmental health – Environmental biotechnology in the 21st century.

REFERENCES:

1. Mac Arthur R.H., **Geographical Ecology: Patterns in the Distribution of Species,** Harper & Row Publications, New York (1972).
2. Pielou E.C., **Ecological Diversity,** John Wiley & Sons, New York (1975**).**
3. Stracey P.D., **Wild Life in India – Its Conservation and Control,** Ministry of Food And Agriculture, Govt. of India, New Delhi (1963).
4. Saharia V.B., **Wild Life in India,**Nataraj Publishers, Dehradun (1982).
5. Seshadri B, **Indian Wild Life Resources,** Sterling Publishers, New Delhi (1982**)**.
6. Chatterji, A.K., **Introduction to Environmental Biotechnology,** Prentice Hall, New Delhi (2005).

Course outcomes

- **Systematically understand biodiversity and its vital role in ecosystem function.**
- **Understand the value of biodiversity and current threats to biodiversity.**
- **Describe Environment of nature.**
- **Explain the conservation of the environment by adopting bio treatment for waste degradation.**

CO-PO Mapping

CO outcomes	PO_1 Knowledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team Work	PO_{10} Communi-cation	PO_{11} Programme Management	PO_{12} Lifelong Learning
CO1	3	2		2		2	3				2	2
CO2	3	2		2	2	2	3				2	3
CO3	3			2		3	2				2	3
CO4	3	2		2		3	3				2	3

ENV 305 (c):: STATISTICS, COMPUTER APPLICATIONS AND MODELING

Course objectives

- **To assess the strengths of the conclusions and evaluating their uncertainty in the data.**

- **To understand importance of computer applications in business, education and research.**
- **To develop appropriate mathematical models to predict environmental changes.**
- **To understand mathematical tools used in modeling.**

UNIT – I

Statistics: Introduction – Measures of central tendencies – Arithmetic Mean – Dispersion – Variance – Standard Deviation – Coefficient of Variation – Simple Correlation – Linear Regression with two variables.
Tests of significance**:** Statistical Hypothesis – Null Hypothesis – Level of Significance – Large sample Tests for means – Sampling Distribution – Standard Error – Small sample tests based on t-distribution.

UNIT – II

Fundamentals of Computers: Introduction to computers – History of evolution - Organization and working of computer – Classification of computers.
Computer Hardware: CPU, Mother Board, Disk Drives, Memory, I/O Devices, Printers and plotters – Network peripherals – Modem.
Computer Software: System Software – Compiler and Interpreter – Application Software – Operating Systems – Fundamentals of DOS, UNIX and Windows operating systems – Computer languages.

UNIT – III

Fundamentals of MS-WORD, MS-EXCEL and MS-POWER POINT.
Computer Network and Internet: Advances of networking – Computer for communication – Internet – Search machines – Sending and receiving E-mail – Downloading files.

UNIT – IV

Ecological Predictions and Mathematical Modeling: Modeling – Nature of Mathematical Models – Basic Mathematical Tools used in Modeling – Elements used in Modeling – Limitations of models – Models for ecological predictions – Lotka-Volterra Model – Leslie's Matrix Model – Air Quality Model.

REFERENCES:

1. Peter Norton, **Introduction to Computers,** Tata McGraw Hill (1998).
2. Alexis Leon and Mathews Leon, **Fundamentals of Information Technology,** Leon Tech World, Chennai (2001).
3. Gupta S.P., Introduction **to Statistical Methods,** Chand Co.,(1985).
4. Gupta S.C. and Kapoor V.K., **Fundamentals of Applied Statistics,** Chand Co.,
5. Rajaraman V, **Fundamentals of Computers,** Prentice Hall of India (2000).
6. Jorgensen S.E., **Applications of Ecological Modeling in Environmental Management,** Elsevier, London (1996).
7. Henry C Perkins, **Air Pollution**, McGrew Hill (1974).

Course outcomes

- **Analyze data using standard statistical techniques.**
- **Utilize the Internet Web resources and evaluate on-line e-business system.**
- **Environmental analysis, forecasting of the environment can be achieved.**
- **Evaluate test significant for ecological predictions.**

CO-PO Mapping

CO outcomes	PO_1 Knowledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team Work	PO_{10} Communi-cation	PO_{11} Programme Management	PO_{12} Lifelong Learning
CO1	3			2		2						3
CO2	3		2	2	2	2				2	2	3
CO3	3		2	2	2	2				2	2	3
CO4	3			2		2					2	2

ENV 306 (a):: NATURAL RESOURCES CONSERVATION

Course objectives

- **To introduce the importance of natural resources and its management.**
- **To integrate technical field knowledge with analytical skills to solve important natural resource management problems.**
- **To understand different practices of agriculture and its impact on environment and food stock.**
- **To understand use and exploitation of mineral and food resources daily life.**

UNIT – I

Natural Resources: Definition – Importance – Classification – Human physiological socio-economic and cultural development – Human Population Explosion – Natural Resource Degradation – Concept of conservation – Value system – Equitable resource use for sustainable life system.

UNIT – II

Forest Resources: Forest cover in India and the World – Importance – Desertification – Forest Wealth – Afforestation – VanasamrakshnaSamithi in A.P. – Agroforestry – Social Forestry – Joint Forest Management Strategy for Forest Conservation.

Wild Life: Resources – Importance – Benefits – Wild life Extinction – Causes for Extinction – List of Endanger species in India and in the World – Ecological approach in wild life management – Eco Tourism – Wild Life projects in India – Sanctuaries and National Parks In India – Man and Bio sphere Programme – Aesthetic type of Conservation by TTD.

UNIT – III

Land and Soil Resources: Soil, Complexity of soil nature, regional deposits, Land use and capability classification systems, Land use Planning models and their limitations. Impacts of natural and man-made activities on land characteristics and land use planning– Soil Erosion – Loss of Soil Nutrients – Restoration of Soil Fertility – Soil Conservation Methods and Strategies in India.

Wet Land Conservation and Management – Ecological Importance of wet lands in India – Conservation Strategy and ecological Importance.

Water Resources: Rivers and Lakes In India – Water Conservation and ground water level increase - - Watershed Programme.

UNIT – IV

Mineral Resources: Use and exploitation – Environmental effects of extracting and using mineral resources – Restoration of mining lands – Expansion of supplies by substitution and conservation.

Food Resources: World Food Problems – Changes caused by agriculture – overgrazing effects of modern agriculture – Fertilizer-Pesticide problems – Water Logging – Salinity – Sustainable agriculture, life stock breeding and farming.

REFERENCES:

1. Haue R and Freed V.H., **Environmental Dynamics of Pesticides**, Menum Press, London (1975).
2. Singh B, **Social Forestry for Rural Development,** Anmol Publishers, New Delhi (1992).
3. Shafi. R., **Forest Ecosystem of the World,** (1992)
4. Trivedi R.K., **Environment and Natural Resources Conservation,** (1994).
5. Murthy J.V.S., **Watershed Management in India,** (1994).
6. Raymond F Dasmann, **Environmental Conservation,** John Wiley (1984).
7. Nalini K.S., **Environmental Resources and Management,** Anmol Publishers, New Delhi (1993).
8. Land use in Mining Area of India, RekhaGhosh,Envis, ISM Dhanbad, ISSN 0972-4656
9. Environmental Land use planning and Management, John Randolph, Island Press.

Course outcomes

- **Application of theories and methods with interdisciplinary approach towards natural resource management.**
- **Critically examining the gap in the resource availability, use and conservation.**
- **Environment conservation and employment generation.**
- **Describe sustainable agriculture management.**

CO-PO Mapping

CO outcomes	PO_1 Knowledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team Work	PO_{10} Communi-cation	PO_{11} Programme Management	PO_{12} Lifelong Learning
CO1	3			2		2	3				2	3
CO2	3			2	2	3	3				2	3
CO3	3			2	2	2	3				2	3
CO4	3			2	2	3	3				2	3

ENV 306 (b):: GLOBAL ENVIRONMENTAL ISSUES

Course objectives

- **To promote an investigation of the scientific principles behind global environmental issues.**
- **To develop a world which is eco-friendly and pro for sustainable development.**
- **To develop new dimensions to environment – human relationships.**

- **To develop non polluting energy resources.**

UNIT - I

Global Climate Changes: Global Warming – Effect of global warming on hydrological cycle – Carbon Budget – Control Measures – Greenhouse Effect – Sources and Sinks of greenhouse gases.

UNIT - II

Atmospheric Pollution in Global Climate: Importance of stratosphere – Ozone depletion – Effect of ozone depletion on environment – Ways of protecting ozone layer – Acid Rain – Impact of acid rain on environment – Major Air Pollution Episodes.

UNIT - III

Radiation and Environment: Sources of radiation – Radioactive pollutants – Radioactive isotopes and their application – Effect of radiation on plants and animals at genetic level – Disposal of radioactive wastes – Nuclear Episodes – Radiation protection and control measures.

UNIT - IV

Future Challenges: Population stabilization - Integrated land use planning – Healthy cropland and grassland - woodland and re vegetation – Conservation of biological diversity – Control of pollution – Development of nonpolluting renewable energy systems – Recycling of waste and residues – Ecologically compatible human settlements and slum improvements – Environmental awareness and education – Updating environmental laws and new dimension to human towards environment.

REFERENCES:

1. Manahan S.E., **Environmental Chemistry,** Lewis Publishers, New York (2000).
2. Daley M.J., **Nuclear Power: Promise or Peril,** Lerner Publishing Minneapolic (1997).
3. Cheremisinoff N.P., Handbook **of Industrial Toxicology and Hazardous Materials,** Marcel Dekker, New York (1999).
4. Botkin, D.B. **Changing the Global Environment,** Academic Press, San Diago (1989).

Course outcomes

- **Predicting the consequences of human actions on quality of human life and global economy.**
- **Developing critical thinking for shaping strategies for environmental protection and its conservation.**
- **Updating the global environmental laws binding on the Governments.**
- **Establish awareness on environment to meet future challenges.**

CO-PO Mapping

CO outcomes	PO_1 Knowledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team Work	PO_{10} Communi-cation	PO_{11} Programme Management	PO_{12} Lifelong Learning
CO1	3	2	2	2	2	2	3				2	2
CO2	3	2	2	2	2	2	3					2
CO3	3	2	2	2		2	3			2	2	2

CO4	3				2	2	3				2	3

SEMESTER-IV

ENV- 401:: WATER RESOURCES AND WATERSHED MANAGEMENT

Course objectives

- **To develop an understanding of the occurrence and availability of freshwater, its uses, and problems related to water resources management.**
- **To learn more about managing our water resources and solve societal and environmental woes.**
- **To understand traditional water conservation methods and equitable use of water for sustainable development.**
- **To develop more rainwater conservation practices for future generations.**

UNIT - I

Introduction: Hydrological Cycle – Formation and its Importance – Rain fall – Surface water – Ground water – Soil water and plant relationship.
Water Table – Water Budget – Global Water Balance and Distribution – Importance of Streams, Rivers, Lakes and Ponds.

UNIT – II

Water and Society: Water Usage – Overdrawing of Water and its consequences – Water shortage – Water Table and Depletion – Surface Water - Causes for diminishing surface water – Land subsidence – Salt water intrusion – Hydraulic gradient – Darcy's Law – Cone of depressions – Capture-zone curves – Control of ground water plumes – Factors for drought formation – Consequence of drought – Problem of irrigation water – Conflicts over water.

UNIT - III

Water Quality and Waste Water Treatment: Population explosion – Causes and Consequences – Water Quality Standards – Need for safe drinking water – Safe Drinking Water Act – Water Quality in Lakes and Reservoirs – Ground Water – Water born diseases – Water distribution and sanitary sewer systems – Sources of water pollution – Waste Water Treatment – Environmental Legislation for water conservation – Water Act 1974 – Future needs and alternate sources of water – Additional Remediation Technology.

UNIT – IV

Water Harvesting and Management: Water Resources – Indian and A.P. Scenario – Traditional Water Management System – Methods for ground water infiltration – Recharge pits for individual house plot – Watershed Management – Catchment Area Developments – Command Area Development – Cropping Pattern – Cloud Seeding – Big Dams – Benefits and Problems – Equitable use of water resources for sustainable growth and development.

REFERENCES:

1. Gilbert M Masters, **Introduction to Environmental Engineering and Science,** Prentice Hall of India Pvt. Ltd. (1998).
2. Kumar A, **Ecology and Conservation of Lakes, Reservoirs and Rivers,** ABD Publishers, Jaipur (2004).
3. Goel P.K., **Water Pollution: Causes, Effects and Control,** New Age International Pvt. Ltd. (1996).
4. Eckenfelder, **Industrial Water Pollution and Control,** Wesley Publications (1997).

5. Sharma V.K., **Water Resources – Planning and Management,** Himalaya Publishing House (1985).

Course outcomes

- **Understand water's importance as a precious resource.**
- **Provide a basic understanding of the impact of water and water-related issues in a global, economic, environmental and societal context.**
- **Describe the management of water resources through construction of watersheds for future generations.**
- **Understand value and role of the water resources for sustainable growth and development.**

CO-PO Mapping

CO outcomes	PO_1 Knowledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team Work	PO_{10} Communi-cation	PO_{11} Programme Management	PO_{12} Lifelong Learning
CO1	3					3	3					2
CO2	3			2		3	3					2
CO3	3	2	2	2	2	2	3				2	3
CO4	3		2	2	2	2	3		2		2	3

ENV - 402:: REMOTE SENSING AND GIS

Course objectives

- **To provide background knowledge and understanding of principles of RS and RS systems.**
- **To enhance capacity to interpret images and extract information on the earth surface from multi-resolution imagery at multi-scale level.**
- **To analyze satellite data in understanding forest, water resources, agricultural and soil coverage.**
- **To find the degradation level of environmental parameters through remote sensing applications.**

UNIT – I

Basic Concepts and Fundamentals: Remote Sensing – Basic concepts – Physics of Remote Sensing – Energy interaction with atmosphere – Energy interaction with earth surface features – Aerial photographs –Interpretation principles and techniques.
Earth Resources Satellites – IRS – Land sat satellites – SPOT, TRS Programmes –Meteorological and ocean monitoring satellites.

UNIT – II

Sensors and Scanners: Sensors – Optical – Thermal – Microwave – Sensor Characteristics – Scanners – Digital – Geocoded – Multispectral and thermal Imagers.

Microwave Remote Sensing: Basic principles – SAR, SLAR Operations – Characteristics of RADAR signals – Earth surface characteristics influencing RADAR returns – Interpretation of microwave data.
Digital Image Processing: Basic principles – Techniques – Image enhancement – Edge enhancement – Image classification – Data merging and GIS Integration – Biophysical modeling.

UNIT – III

Satellite Data Applications: Resource management – Forest, Water, Ground Water, Soil, Agricultural, Land use, Wasteland – Quantitative Estimation – Yield Estimation – Coastal Zone Changes.
GIS Applications: Fundamentals of GIS – Applications for Infrastructure, Ground Water, Land use planning, Watershed management – Rainfall, Runoff etc. – GPS types and applications.

UNIT – IV

Environmental Applications of RS and GIS: Impact Assessment – Pollution Monitoring – Land Degradation – Desertification – Industry – Mining – Ground Water – Damage Assessment – Coastal and Marine applications – Satellite System – IKONAS – QUICKBIRD – CARTOSAT – ENVISAT – TRMM – EOS Missions – Integral Earth Observation Studies – Global Change.

REFERENCES:

1. Berry S Siegal and Allen R Gillspie, **Remote Sensing in Geology,** Tata McGraw Hill Publishing Co. (1987).
2. Lillesand and Kiefer, **Remote Sensing and Image Interpretation,** John Wiley (1987).
3. Chouhan and Joshi K.N., **Applied Remote Sensing and Photo Interpretation** (1991).
4. Rajan M.S., **Remote Sensing and GIS for Natural Resources.**
5. Elangovan, **GIS Fundamentals, Applications and Implications,** NIPA, New Delhi (2006).
6. Elachi C, **Introduction to Physics and Techniques of Remote Sensing,** John Wiley, New York (1978).

Course outcomes

- **Laying foundations for understanding Remote Sensing and Geographic Information System as a powerful tool for geospatial analysis.**
- **Evaluating the application of RS-GIS techniques to the matrices of environment and resource management.**
- **Future predictions of the environment will be known about weather.**
- **Explain the damages occurred in the environment by GIS.**

CO-PO Mapping

CO outcomes	PO_1 Knowledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team Work	PO_{10} Communi-cation	PO_{11} Programme Management	PO_{12} Lifelong Learning
CO1	3		2	2	2	3	3				2	2
CO2	3		2	2	2	3	3				2	2
CO3	3		2	2	2	2	3				2	3
CO4	3		2	2	2	2	3				2	3

ENV - 403: PRACTICAL-I

Course objectives

- **To estimate the various metals by using instrumental techniques.**
- **To understand the coverage of watershed development from aerial photos.**

- **To recognize geomorphological characters from aerial survey.**

1. Determination of amount of Zn, Cu and Cr in surface water.
2. Estimation of amount of E-coli in drinking water.
3. Estimation of the amount of NO_2^-, NO_3^- in ground water samples.
4. Interpretation of drainage characteristics from aerial photographs.
5. Geo morphological Characters Appreciation from aerial photos.
6. Watershed development from aerial photos.

Course outcomes

- **Analyze the multi elements in various wastewater samples.**
- **Understand the quality of ground water.**
- **Describe extend of drainage area with its hazardous characters.**

ENV- 404: PROJECT WORK AND COMPREHENSIVE VIVA-VOCE

Course objectives

- **To understand the concepts of project management for better execution of projects.**
- **To identify the different funding agencies for environmental protection.**
- **To develop valuable social networking which increases public participation in environmental management.**

Course outcomes

- **Understanding project characteristics at its various stages of implementation.**
- **Estimating the cost of physical and human resources and making plans to obtain the necessary resources.**
- **Developing young researchers with appropriate exposure and necessary training.**
-

ENV 405 (a):: DISASTER MITIGATION AND MANAGEMENT

Course objectives

- **To obtain, analyze and communicate information on risks and relief needs.**
- **To assess review and control the risk.**
- **To develop methods of risks analysis and evaluation of accidents in industrial development.**
- **To inculcate economic evaluation of risks after the disaster.**

UNIT-I

Natural disasters: Cyclone – Tornadoes – Avalanches – Flood – Drought – Volcano – Earthquake – Fire – Landslide – Forecasting and Warning System – Disaster Education – Safety Measures – Impact on environment.

UNIT-II

Disaster Management: Pre-disaster Planning – Toning of disaster prone areas – Prioritization – Regulations – Protection measures during disaster – Post-disaster Relief Camp Organization – Survey and Assessment – Disaster Management Cycle - Vulnerability Analysis – Warning System – Legal Aspects – Case Studies for disaster management.

UNIT-III

Disaster preparedness and training: Community preparedness in natural disasters – Role of NGOs, Executives and Army for disaster reduction and mitigation in local conditions.

UNIT-IV

Risk Analysis and Assessment: Basic concepts – Purpose of risk analysis – Tools for risk assessment – Toxicology – Epidemiology **-** Exposure Modeling – Significance of risk and management – Evaluation of accidents in industrial processes – Assessment of risk to ecosystem and human health from GMOs – Psychology of risk – Economic evaluation of risks – Experiences of World Bank – Risk Communication – Frame work for sustainable development.

REFERENCES:

1. Cuttler S, **Environmental Risk and Hazards,** Prentice Hall of India, New Delhi (1994).
2. Shailendra K Singh, Subhash C Kundu and Shobu Singh, **Disaster Management,** Mittal Publications, New Delhi (1998).
3. Ricci P.F. and Rowe M.D. (ed), **Health and Environmental Risk Assessment,** Pergman Paper, New York (1985).
4. Peter Calow, **Environmental Impact Assessment,** McGraw Hill Inc., New Delhi (1998).

Course outcomes

- **Understand the mitigation approaches, their choices and alternatives.**
- **Develop foundations for hazard, risk and vulnerability assessment.**
- **Explain the knowledge on disaster preparedness to meet risks in natural disasters.**
- **Know about the economic evaluation of risks and frame work for sustainable development.**

CO-PO Mapping

CO outcomes	PO_1 Knowledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team Work	PO_{10} Communi-cation	PO_{11} Programme Management	PO_{12} Lifelong Learning
CO1	3	2	2			2	3					2
CO2	3	2	2	2		2	3				2	3
CO3	3			2		3	2				2	3
CO4	3	2		2		3	3				2	3

ENV 405 (b):: ENVIRONMENTAL LAWS, POLICIES AND LEGISLATION

Course objectives

- **To prevent, minimize, remedy and punish actions that threaten or damage the environment.**
- **To preserve and protect the nature's gifts from pollution by implementation of environmental laws and policies.**
- **To understand environmental public policy strategies in pollution control.**
- **To understand environmental laws and acts for protect and conservation of environment.**

UNIT – I

Environmental Protection: Need – Issues - Problems and Awareness – International and National Efforts for Environmental Protection – Agenda 21- Environmental Ethics and Global Imperatives – Current Environmental Issues in India – Constitutional Amendments – Article 48 A & 52 A.

UNIT – II

Environmental Legislation: Scope and importance – Key concept of environmental management and approaches – Environmental legislation and punitive control – Objectives of legislation and frame work in the country – Planning and enforcement – Environmental Organizations – Information exchange and surveillance – EIA Notification in 1994 – ISO 14000 – EMS Standards.

UNIT – III

Environmental Policy in India: Need for policies- Public Policy – Economic policies – Relationship between economic development and environment – Implementing Environmental Public Policy Strategies in pollution control – Constitutional provisions in India regarding environment – Public Awareness and Participation in Environmental Management – National Land Use Policy 1988 – Industrial Policy 1991.

UNIT– IV

Environmental Laws and Acts: Environmental Laws – Need – Indian Prospective – National Committee on Environmental Planning (NCEP) – Role of Indian Judiciary in the protection of Environment : Forest Conservation Act, 1980, Indian Forest Act (Revised) 1982, Wild Life Protection Act, 1972 amended 1991, Air (Prevention and Control of pollution) Act 1981 amended 1987, The Water (Prevention and control of pollution) Act 1988, Motor Vehicle Act 1988, Hazardous Waste Management Act 1989, Biomedical Waste Act 1999, Plastic Act 2000 – Municipal solid waste Act 1999, Public Liability Insurance Act 1992 - Biodiversity and WTO (1988) – Convention on biological diversity (1992) – Ecological, Economic, Aesthetic and other importance of Biological diversity.

REFERENCES::

1. Trivedi R.K., **Handbook of Environmental Laws, Guidelines, Compliances and Standards, Vol I and II,** B.S. Publications.
2. Newson M.M., **Managing the Human Impact on the Natural Environment: Patterns and Processes,** International Book Distributor, Dehradun (1993).
3. Keith Thomas, **Man and Natural World – A History of Modern Sensibility,** Pantheon, New York (1983).
4. Jadav H and Bhosale V.M., Environmental **Protection and Laws, Himalaya** Publications (1995).
5. Shyam Divan and Armin Rosencranz, **Environmental Law and Policy in India, Oxford** Uni. Press (2001).

Course outcomes

- **Understanding judicial response to environmental issues in India.**
- **Acquiring the ability to evaluate the role of law and policy in conservation and management of natural resources and prevention of pollution.**
- **It enhances the societies support for environment's protection programmes.**
- **Develop the environmental quality through implementation of environmental laws and acts.**

CO-PO Mapping

CO outcomes	PO_1 Knowledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team Work	PO_{10} Communi-cation	PO_{11} Programme Management	PO_{12} Lifelong Learning
CO1	3	2		2	3	2	3				2	3
CO2	3	2		2	3	3	3				3	3
CO3	3	2		2	3	2	3				2	3
CO4	3	2		2	3	2	3				2	3

ENV 405 (C):: ENVIRONMENTAL MANAGEMENT AND SUSTAINABLE DEVELOPMENT

Course objectives

- **To develop skill in management of environment in a global level.**
- **To understand the environmental knowledge into action in order to achieve particular outcomes in the way landscapes, societies and/or natural ecosystems are used and managed.**
- **To provide skills and an improved understanding of how firms and organisations work with sustainability issues.**
- **To understand sustainable environmental management by implementing policy principles.**

UNIT-I: Environmental Management

Implementation of Environmental Management System- EMS definition Environment Policy and components of EMS-Identification of environmental aspects and impacts

UNIT II: Management tools

Implications of Environmental Management tools for Environmental Management-Environmental legislations, institutions and policies with special reference to India- Policy responses to environmental degradation.

UNIT-II: Management requirements

Legal and other requirements-Training and awareness requirements- Application of Environmental Standards- ISO standards and history of their development.

UNIT IV: Sustainable Development

Concept of sustainable development- key principles - poverty and sustainable development Environmental management - innovation strategies for sustainable development - Governance for sustainable development.

REFERENCES:

1. Cunningham W and Cunningham M.A., **Principles of Environmental Science,** McGraw Hill, London (2003).
2. Joseph K and Nagendran R, **Essentials of Environmental Studies,** Pearson Education, Delhi (2004).
3. Agarwal K.M., Sikdar P.K. and Deb S.C., **A Text Book of Environment,** Mac Millan India Ltd, Kolkatta (2002).
4. Tyler Miller Jr. G, **Living in the Environment – Principles, Connections and Solutions,** Wadsworth Publishing Co., New York (1996).
5. Wright R.T. and Nebel B.J., **Environmental Science – Towards Sustainable Future,** Prentice Hall, New Delhi (2002).

Course outcomes

- **Explain the environmental management practices.**
- **Ability to analyze environmental management in relation to the major principles of sustainable development.**
- **The ability to work effectively to create environmental management analysis outputs of professional quality, both independently and within team environments.**
- **Develop innovation strategies for sustainable development at local and national level.**

CO-PO Mapping

CO outcomes	PO_1 Knowledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team Work	PO_{10} Communi-cation	PO_{11} Programme Management	PO_{12} Lifelong Learning
CO1	3					3	3					2
CO2	3					3	3					2
CO3	3					2	3					2
CO4	3					2	3				2	3

ENV-406 (A) FOREST RESOURCES AND MANAGEMENT

Course objectives

- **To provide desired physical, chemical and biological soil processes and functions on the Forests to maintain and/or improve soil productivity.**
- **To create basic strategies for forest management like plantation forestry, natural forest management and agroforestry.**
- **To build synergy with national and international agencies on environmental conservation.**
- **To awareness of the disadvantages of deforestation and further conservation.**

UNIT-I

Introduction – Forest Ecology – Basic concept and approaches to ecology – community ecology – characters used in community structure – Habitat ecology – Fresh water, marine, estuarine terrestrial ecology – desert ecology.

UNIT-II

Phytogeography: Major plant communities of the world – phytogeographical regions of the world - Soil climate – Flora and vegetation of India – Floristic regions of India – Endemism.

UNIT-III

Environmental Organizations and Agencies: National and International environmental organizations – Ministry of Environment and Forest (government) – International Agency Frame Work on environmental conservation.

UNIT-IV

Emerging concepts in conservation of forest and action plan – Conserving forest genetic resource from theory and practice – Action Plans and research need to conservation – Threats and mitigation measures.

REFERENCES:

1. Odum E.P., **Fundamentals of Ecology,** WB Saunders Co., London (1971).
2. Ramakrishnan P.S., **Mountain Biodiversity, Land Use Dynamics, Traditional Ecological Knowledge,** Oxford and IBH Publications Pvt. Ltd., New Delhi (2000).
3. Krishnamurthy K.V., **An Advanced Text Book on Biodiversity,** Oxford and IBH Publications Pvt. Ltd., New Delhi (2004).
4. Ramesh B.R. and Pascal J.P., **Atlas of Endemics of the Western Ghats,** French Institute, Pondichery (1997).

Course outcomes

- **Demonstrating knowledge of forest vegetation modeling to forecast its development over time.**
- **Integrating knowledge of basic biology, physical and social sciences, forest and wildlife ecology.**
- **Through forest management national economy will be improved.**
- **Describe preparation and development of action plan for conservation of forests**

CO-PO Mapping

CO outcomes	PO_1 Knowledge	PO_2 Analysis	PO_3 Design	PO_4 Development	PO_5 Modern Tools	PO_6 Society	PO_7 Environment	PO_8 Ethics	PO_9 Team Work	PO_{10} Communi-cation	PO_{11} Programme Management	PO_{12} Lifelong Learning
CO1	3	2	2	2		2	3				2	2
CO2	3	2				2	3					2
CO3	3					2	3			2	2	2
CO4	3				2	2	3				2	3

ENV- 406 (b): ENVIRONMENTAL EDUCATION AND SUSTAINABILITY

Course objectives

- **To indentify the interconnected and interdisciplinary nature of environmental studies.**
- **To expand the knowledge of liberal arts for understanding the relationship between humans and their environment.**
- **To analyze environmental priorities and develop appropriate strategies for programme implementation.**
- **To understand environmental education and awareness for sustainable development.**

UNIT – I

Knowledge of Environment: About the environment – Humanity-Environment relationship – Population growth – Problems – Rational use of resources – Objectives of environmental education – Guiding principles – UNESCO 1977 recommendations – Environmental programmes – Environmental education in India – Classification of environmental education programmes.

UNIT – II

Environmental Education: Environmental education at primary, secondary and tertiary level – Non-formal environmental education – Environmental education for professional level groups.

Environmental Organizations and Agencies: International Bodies, MAB, Government and Non-government (Voluntary) Organizations – Environmental administrative control – Central and State Pollution Control Boards – Department of Environment and Forests – Special Technologies.

UNIT – III

Sustainable Development: Definition, Scope and Importance – Causes of unsustainablity – Ecological footprints – Guidelines for sustainable development and reduction of poverty – Earth's ethics for sustainable living – Ethical guidelines – UN Conference on human environment – Environment and Development and Earth Summit.

UNIT – IV

Future Challenges to Society: Environmental priorities in India and strategies for action – Population stabilization – Integrated land use planning – Healthy cropland and grassland – Woodland and revegetation – Conservation of biological diversity – Control of pollution – Development of non-polluting renewable energy systems – Recycling of waste and residues – Ecologically compatible human settlements and slum improvements – Environmental education and awareness – Updating environmental laws – Rain water harvesting and new dimensions to national security.

REFERENCES:

1. Cunningham W and Cunningham M.A., **Principles of Environmental Science,** McGraw Hill, London (2003).

2. Joseph K and Nagendran R, **Essentials of Environmental Studies,** Pearson Education, Delhi (2004).
3. Agarwal K.M., Sikdar P.K. and Deb S.C., **A Text Book of Environment,** Mac Millan India Ltd, Kolkatta (2002).
4. Tyler Miller Jr. G, **Living in the Environment – Principles, Connections and Solutions,** Wadsworth Publishing Co., New York (1996).
5. Wright R.T. and Nebel B.J., **Environmental Science – Towards Sustainable Future,** Prentice Hall, New Delhi (2002).

Course outcomes

- **Demonstrating an integrative approach to environmental issues with a focus on sustainability.**
- **Communicating complex environmental information to both technical and non-technical audiences.**
- **Enriches the students with knowledge of environmental problems and appropriate solutions to overcome them.**
- **Describe the eco-friendly techniques to meet future challenges.**

CO-PO Mapping

CO outcomes	**PO_1 Knowledge**	**PO_2 Analysis**	**PO_3 Design**	**PO_4 Development**	**PO_5 Modern Tools**	**PO_6 Society**	**PO_7 Environment**	**PO_8 Ethics**	**PO_9 Team Work**	**PO_{10} Communi-cation**	**PO_{11} Programme Management**	**PO_{12} Lifelong Learning**
CO1	3			2		2	3				2	3
CO2	3			2		3	3				2	3
CO3	3			2		2	3				2	3
CO4	3			2		2	3				2	3