Syllabus- CBCS

National Education Policy (NEP) - 2020

M. Sc., ENVIRONMENTAL SCIENCE
2 Year PG Course

Approved by Board of Studies from the year 2024-2025 onwards

DEPARTMENT OF ENVIRONMENTAL SCIENCE
SVU COLLEGE OF SCIENCES
SRI VENKATESWARA UNIVERSITY

SRI VENKATESWARA UNIVESITY, TRUPATI-517 502, A.P., INDIA

M.Sc. Environmental Science Syllabus
(For Two year PG Program with Course Work in First 3 semesters and project work in fourth semester of second year)
Academic Year 2024-2025

SEMESTER – I								
S. No	**Course**	**Code**	**Title of the Course**	**H/W**	**C**	**SEE**	**IA**	**Total Marks**
1	CC	101	Core course - 1	4	4	70	30	100
2		102	Core Course – 2(A)	4	3	50	25	75
			Core Course – 2(B)					
3		103	Core Course – 3(A)	4	3	50	25	75
			Core Course – 3(B)					
4	*P	104	Practical- I (related to CC 2 & 3)	6	2	35	15	50
5	SOC	105	Skill Oriented Course – 1(A)	4	3	50	25	75
			Skill Oriented Course – 1(B)					
6		106	Skill Oriented Course – 2(A)	4	3	50	25	75
			Skill Oriented Course – 2(B)					
7	*P	107	Practical- II (related to SOC 1 & 2)	6	2	35	15	50
			Total	**36**	**20**	**340**	**160**	**500**
8	Audit Course	108	Indian Knowledge Systems - 1	4	0	0	100	0

SEMESTER – II								
S. No	**Course**	**Code**	**Title of the Course**	**H/W**	**C**	**SEE**	**IA**	**Total Marks**
1	CC	201	Core course - 4	4	4	70	30	100
2		202	Core Course – 5(A)	4	3	50	25	75
			Core Course – 5(B)					
3		203	Core Course – 6(A)	4	3	50	25	75
			Core Course – 6(B)					
4	P	204	Practical- III (related to CC 5 & 6)	6	2	35	15	50
5	SOC	205	Skill Oriented Course – 3(A)	4	3	50	25	75
			Skill Oriented Course – 3(B)					
6		206	Skill Oriented Course – 4(A)	4	3	50	25	75
			Skill Oriented Course – 4(B)					
7	P	207	Practical -IV (related to SOC 3 & 4)	6	2	35	15	50
8	OOTC	208	Open Online Transdisciplinary Course – 1	-	2	-	100	100
			Total	**36**	**22**	**360**	**260**	**600**
9	Audit Course	209	Indian Knowledge Systems - 2	4	0	0	100	0

SEMESTER – III								
S. No	**Course**	**Code**	**Title of the Course**	**H/W**	**C**	**SEE**	**IA**	**Total Marks**
1	CC	301	Core course – 7	4	4	70	30	100
2		302	Core Course – 8(A)	4	3	50	25	75
			Core Course – 8(B)					
3		303	Core Course – 9(A)	4	3	50	25	75
			Core Course – 9(B)					
4	P	304	Practical- V (related to CC 8 & 9)	6	2	35	15	50
5	SOC	305	Skill Oriented Course – 5(A)	4	3	50	25	75
			Skill Oriented Course – 5(B)					
6		306	Skill Oriented Course – 6(A)	4	3	50	25	75
			Skill Oriented Course – 6(B)					
7	P	307	Practical- VI (related to SOC 5 & 6)	6	2	35	15	50
8	OOTC	308	Open Online Transdisciplinary Course – 2	-	2	-	100	100
*	Seminar / tutorials / remedial classes and Quiz as part of internal assessment			4	-	-	-	-
			Total	**36**	**22**	**340**	**260**	**600**

SEMESTER – IV								
S. No	**Course**	**Code**	**Title of the Course**	**H/W**	**C**	**SEE**	**IA**	**Total Marks**
1	OOSDC	401	Open Online Skill Development Courses	-	8	-	200	200
2	PW	402	Project Work – Orientation classes	24	12	300	0	300
*	Conducting classes for competitive exams, communication skills, UGC / CSIR and NET / SLET examinations			12	-	-	-	-
			Total	**36**	**20**	**300**	**200**	**500**
Total Semesters				**144**	**84**	**1320**	**880**	**2200**

DEPARTMENT OF ENVIRONMENTAL SCIENCES

Vision

- Acquire knowledge in the fields of environmental issues Air, Water and Soil.
- Impart knowledge in overall development to meet the global need for future generations.
- Create awareness on energy and non-convectional energy resources for Green India and Green health development.

Mission

- To develop nurture and empower the students to their full potential to cope up with the environmental challenges for achieving the sustainable development.
- To understand and tackle environmental issues with multidimensional approach.
- To adopt state of the art of technology to optimize use of teaching and research for enhancing knowledge, skills and entrepreneurship amongst the youth.
- To undertake quality research in providing insight on the interactions between different forms of life.

DEPARTMENT OBJECTIVES

- To provide courses in National Education Policy (NEP-2020) to improve intellectual foundation and academic preparation for life in a complex, dynamic technological world.
- To make the students to apply their knowledge for efficient environmental decision-making, management and sustainable development.
- To create an awareness in monitoring environmental issues at global level.
- To organize efforts to teach how natural environments function, and particularly, how human beings can manage behavior and ecosystems to live sustainably.
- To make students more engaged, motivated, and increase their overall learning ability.
- To develop and test scientific hypotheses using critical thinking skills and contemporary tools.
- To develop the policy to address environmental problems such as biodiversity loss, pollution, resource depletion and climate change.
- To serve the society by promoting science and technology.
- To prepare students for successful career in environmental departments, research institutes, industries, consultancy and NGOs, etc.

CHOICE BASED CREDIT SYSTEM (CBCS):

The CBCS offers students an opportunity to choose from a set of courses that include core, elective and skill based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. The grading system maintains uniformity in the evaluation and calculation of Cumulative Grade Point Average (CGPA) based on students' performance in examinations,

which enables a student to move into higher education. Uniformity in the evaluation process also allows for probabilistic approaches in assessing candidate performance.

PROGRAMME OBJECTIVES:

PO_1 : To create and disseminate knowledge to the students about environmental problems at local, regional and global scale.

PO_2 : To make the students to apply their knowledge for efficient environmental decision-making, management and sustainable development..

PO_3 : To inculcate ethics and lifelong learning in ecosystem imbalance, impact, control practice considering society, health and environment.

PO_4: Acquired skills in the preparation,planning and implementation of environmental projects.

PO_5 : To create an awareness on Engineering Ethics and Human Values.

PROGRAMME EDUCATIONAL OBJECTIVES

- To enable students to use their knowledge for effective environmental decision-making, management and sustainable development.
- Understand how interactions between organisms and their environments drive the dynamics of individuals, populations, communities and ecosystems.
- Use quantitative reasoning, observational, technical, and analytical skills for scientific problem-solving and interpretation of environmental data.
- Understand the historical and social context of ecological thought and research and the contribution of ecology to the solution of ethical, social and environmental problems in human affairs.
- To prepare students for a successful career in environmental departments, research institutes, industries, consultancy and NGOs etc.

PROGRAMME OUTCOMES:

PO_1 : Describe programs for environmental protection by implementing eco-friendly measures for human existence.

PO2 : By knowing pollution levels in the environment, the best possible fresh environment can be created through different methods like afforestation, natural parks, and sanctuaries for human concern.

PO_3 : Imparting practical knowledge about estimation of pH, Total Dissolved Solids, Hardness and Dissolved Oxygen, Chlorides and Sulphates in water samples.

PO_4 : Inform, educate, and empower people about the potential hazards of toxic substances to Environmental and human health.

PO_5 : They explain basic competence regarding environmental impacts arising from different energy carriers and technical solutions.

PO_6 : Pollution free environment for human life will be achieved.

PO_7 : Applications of basic scientific principle in the evaluation of pollution by instruments.

PO_8 : Environmental potentiality will be achieved. This is indirect benefits to the society.

PO_9 : Discuss the solid waste collection systems, route optimization techniques and processing of solid wastes.

PO_{10}: Critically examine assumptions inherent in impact assessment, examine a range of environmental impact assessments and identify and explore impact assessment fields and approaches.

PO_{11} : Understand requirement of oxygen for growth of organisms to break down organic matter in wastewaters.

PO_{12} : Evaluating the application of RS-GIS techniques to the matrices of environment and resource management.

PROGRAMME SPECIFIC OUTCOMES

- Understand the basic concepts of Environments and its components along with their interactions through study of Ecology, Biodiversity, Environmental Chemistry, and Environmental Pollution and Environmental Impact Assessment.
- Ability to collect, input, process and analyze environmental data using research skills and laboratory and field techniques.
- Develop various skills like observation, discussion, interpretation, experiment through interaction with immediate environment.
- Able to explain how perceptions of environmental issues, problems and proposed solutions are shaped by their historical, geographical, social, political, economic and cultural contexts.

- Determine the environmental impact due to different developmental projects and find solution to eliminate these impacts.

SEMESTER – I

ENS. 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

ENS. 102 (A) :: 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. SubbiahBaljiNanobiotechnology, 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	PO_{12} Lifelong Learning

											Management	
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

ENS. 102 (B) :: SOIL BIOLOGY

Course objectives

- To understand role of microbes in soils.
- To explain soil biota in ecosystem management.
- To understand role of soil nutrients in plant growth.
- To explain bioremediation technique to remove contaminants from soil.

UNIT-I

Soil genesis and provenance, pedosphere, Soil organic matter: sources, composition, microbial decomposition of organic matter, Humus formation Taxonomy and biology of soil organisms. Position and role of soil fauna in soil, ecological niche. Economic importance of soil microbes.

UNIT-II

Role of soil biota in ecological interactions such as biological invasions, allelopathy or plant-soilfeedbacks. Effects of soil-driven unrgulates on plant communities.

UNIT-III

Root exudates: fate of plant allelochemicals in soil. Effect of root exudates on soil biota, and its role on plant growth. Role of soil biota in nutrient cycles such as carbon, nitrogen, sulphur, phosphorus.

UNIT-IV

Soil mutualistic associations: mycorrhizal (arbuscular, ecto-and ercoid) symbioses, role ofmycorrhizae in biological invasion, nitrogen fixing symbioses. Environmental problems related to soils in India: desertification, salinization, and erosion. Brief account of bioremediation of contaminated soils and ground water, soil composting.

REFERENCES:

1. Alexander, M. 1977. Introduction to Soil Microbiology (2ndEdn.) Wiley John.
2. Alexander, M. 1994. Biodegradation and Bioremediation, Academic Press.
3. Anderson, J.M. and Ingram, J.S.I. eds. 1989. Tropical Soil Biology and Fertility (p. 171). Wallingford:CAB international

Course outcomes

- Understand composition of organic matter in soil.
- Describe ecological interactions of soil microbes.
- Explain the soil and plant relation.
- Know about the environmental problems of desertification, salinization and soil erosion.

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		1	3	2	3				2	3

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

ENS. 103 (A) ::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	PO_{12} Lifelong Learning

											Management	
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

ENS. 103 (B) :: ENVIRONMENTAL GEOLOGY

Course objectives

- To impart the knowledge in formation of biogeochemicals.
- To understand the geological hazards.
- To inculcate the natural calamities.
- To understand value of minerals in the Earth.

UNIT – I

Earth processes, Geological cycle, Tectonic cycle, Rock cycle, Hydrological cycle, Special problems of time and scale in geology, concept of residence time and rates of natural cycles.

UNIT – II

Catastrophic geological hazards, prediction and perception of the hazards and adjustmentto hazardous activities.

UNIT – III

River flooding- causes, nature and frequency of floods. Landslides- causes, intensity and magnitude. Volcanism nature extent and causes, Volcanism and climate. Avalanches causes and effects.

UNIT – IV

Mineral and human use, geology of mineral resources, EIA of mineral development, recycling of mineral resources.

References

1. Environmental geology- Edward A. Keller
2. Physical geology - C.W. Montgomery.
3. Geology of India - National book trust series.

Course outcomes

- Explain the formation of natural cycles.
- Understand the Prediction and perception of the hazards.
- Explain the solutions for flood management.
- Understand the EIA management for mineral 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		1	2	2	1					1
CO2	2	2		1	2	2	1					1
CO3	1	2		2	1		2					3

CO4	2	2		2		2	2					2

ENS. 104- PRACTICAL-I

ENS-102- Environmental Toxicology and Public Health
&
ENS-103- Energy and Environment

1. Estimation of the amount of LC_{50} of Pb in organisms.
2. Estimation of the amount of LC_{50} of Cd in organisms.
3. Determination of the amount of pesticide/insecticide in water/vegetable samples.
4. Production of biogas in laboratory.
5. Photovoltaic applications of solar cell.
6. Production of biogas in laboratory.

ENS. 105 (A):: TOOLS AND TECHNIQUES IN ENVIRONMENTAL SCIENCES

(Skill Oriented Course)

Course objectives

- To understand the techniques for identification of environmental pollutants.
- To assess the pollution load in environmental samples.
- To estimate the concentrations of various environmental pollutants.
- To understand the importance of different advance techniques in pollution monitoring.

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

- Explain the various instrumental techniques.
- Understand the load of pollutants by using tools and techniques.
- Explain the solutions for minimization of environmental pollutants.
- Understand the developments in environmental education.

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

ENS. 105 (B) :: OCCUPATIONAL HEALTH AND INDUSTRIAL SAFETY

(Skill Oriented Course)

Course Objectives

- To provide knowledge in understand hazardous material in industrial area.
- To understand general health education and surveillance.
- To identify unrecognized hazardous materials in and around factory.
- To create awareness on handling of hazards material.

UNIT- I: Occupational Health

Hazards and Safety–Physical, Chemical and Biological hazards. Occupational Diseases and Occupationally induced illness - Prevention and Control. Health problems in different types of industries. Measures for Workers. Health Education Medical First- Aid and Management of Medical Emergencies. Epidemiological approaches. Ergonomics.

UNIT- II: Industrial Safety Management Techniques

Industrial Safety Standards. Dispersion of Radioactive material and release of Toxic and inflammable materials. Work Study – Method of Study and Measurement. Measurement of Skills. Safety - Cost of ExpENVes. Principles and Functions in Safety Management.

UNIT- III: Hazards Exposure evaluation

Sampling techniques, Personal monitoring, Biological monitoring; Threshold Limit Values (TLV), STEL; List of Industries involving Hazardous process Occupational Hazards under the First Schedule of the Factories Act,1948; Permissible Limits of certain Chemical substances in work Environment under the Second Schedule of the Factories Act,1948.

UNIT- IV: Hazards Control

Causes of Accident – Theory of accidents, Accident Reporting system, Safety Audit, Accident prevention, Safety Committee, Case studies on Bhopal, Chernobyl and similar disasters - Control of Hazards Substitutions, Isolation, Personal Protective Equipment (PPE).

REFERENCES

1. A B C of Industrial Safety, Walsh, W and Russell, L, (1984), Pitma Publishing United Kingdom.
2. Della D.E., and Giustina, 199Ö, DzSafety and Environmental Management, Van NostrandReinhold International Thomson Publishing Inc.
3. Environmental and Industrial Safety, Hommadi, A. H. (1989), I.B.B Publication, New Delhi.
4. Environmental Strategies–Hand Book, Kolluru R. V, (1994) McGraw Hill Inc., New York.
5. Goetsch D.L.,1990, Occupational Safety and Health for Technologists, Engineers and Managers, Prentice Hall.

Course outcomes

- Explain the precautions for health of the employees at working site.
- Understand safety precautions.
- Explain the solutions for causes of accidents.
- Illustrate the importance of personal protective equipment.

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

ENS-106 (A): FOOD ADULTERATION AND ANALYSIS
(Skill Oriented Course)

Course Objectives

- To provide knowledge in understand food adulteration.
- To assess contamination of the food materials.
- To identify food adulterations in various food samples.
- To create awareness in microbial contamination and on food safety.

UNIT-I: Microbial Contamination:

Food as a substrate for microorganisms: factors affecting microbial growth-physicalchemical - biological.
Bacteria, Molds, Yeasts and Viruses: General characteristics, classification – morphological characteristics – cultural characteristics.Significance of food microbiology

UNIT-II: Food Spoilage:

Microorganisms causing spoilage – chemical- physical - physiological changes caused by microorganisms. Spoilage:Different types of food spoilages.

UNIT III: Food Contamination:

Natural and Environmental contaminants - Food contamination- Sources of contamination in: - Cereals, Legumes, nuts and oil seeds. - Sugars and sugar products. - Fruits and Vegetable products. - Milk and Milk products. - Spices and condiments - Eggs, poultry and Meat. - Fish and Other sea foods. - Processed foods.

UNIT-IV: Food Safety:

Concept- factors affecting food safety –physical- chemical –biological hazards. Food hazards of microbial origin – food borne disease- food borne intoxicationsfood borne infections.

Analysis- Estimation of protein- starch- fat and oils- saturated food- aflatoxin-microbial count- serial dilution techniques- biosensors- growth medium for microbes.

REFERENCES:

1. Adams,M.R. and Moss,M.O.(2003). Food Microbiology, Second edition, Panima Publishing Corporation, New Delhi.
2. George J. Banwart. (2002). Basic Food Microbiology, Second edition, CBS Publishers and Distributors, New Delhi, 2002.
3. James,M.Jay.(2005). Modern Food Microbiology, 4th edition, CBS publishers and Distributors, New Delhi. 25
4. Kalaichelvan,P.T. (2005). Microbiology and Biotechnology, A laboratory Manual, 1st edition, MJP Publishers, Chennai.
5. Mansi EI Mansi and Charlie Bryce. (2004). Fermentation Microbiology and biotechnology, Ist edition, Taylor and Francis Group, Kundli.
6. Michacl,J., Waites, N., Morgan et al,(2000). Industrial Microbiology- An introduction, Ist edition, Black well Science, London.
7. Miller,B.M. and Litsky, W. (1996). Industrial Microbiology, McGraw Hill book company, New York.
8. Lehningar, 2021. Principles of Biochemistry.
9. U. Sathya Narayan, Textbook of Biochemistry.

Course outcomes

- Explain the precautions for health of the employees at working site.
- Understand safety precautions.
- Explain the solutions for causes of accidents.
- Illustrate the importance of personal protective equipment.

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

ENS.106 (B):: SOLID AND HAZARDOUS WASTE MANAGEMENT
(Skill Oriented Course)

Course objectives

- To understand excess generation of the waste.
- To emphasize on design considerations of various unit operations and processes of waste.
- 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

Solid Waste Pollution: Types, sources and consequences. Classification of wastes (Industrial, Municipal, Hospital) Recycle, Reuse, Reduce, Utilization of solid wastes into energy/manure, Disposal methods-non hazardous and hazardous solid waste, Basel Convention on transport of Hazardous Wastes.

UNIT – II

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.

UNIT-III

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).
7. Encyclopedia of Environmental Pollution and Control. Trivedy, R. K (1994) Environ media Publications, Karad.
8. Environmental Pollution Management and control for sustainable development. Khitoliya R. K. (2014) S. Chand and Company Pvt. Ltd., New Delhi.

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

ENS. 107- PRACTICAL- II

ENS-105- Tools and Techniques in Environmental Sciences
&
ENS-106- Food Adulteration and Analysis

1. Determination of Manganese by Spectrophotometer.
2. Determination of Nickel by Spectrophotometer.
3. Estimation of biochemical toxicity by AAS.
4. Estimation of lactic acid in milk sample.
5. Determination of adulterants of dried papaya seeds in pepper.
6. Estimation of microbial origin in foods products.

Audit Course

ENS- 108 - Indian Knowledge Systems-1

Course objectives:

- To help to study the enriched scientific Indian heritage.
- Gain an understanding of Indian Knowledge System.
- Develop an ability to apply the Indian Knowledge System to societal challenges faced today in areas such as holistic health, governance, public administration and sustainable living.

Unit I : **Introduction to Indian Knowledge Systems (IKS)**: About Indian Knowledge System; Definition of Indigenous/ Traditional Knowledge; Scope, and Importance of Traditional Knowledge.

Unit II : **Indian Heritage of Knowledge**: Ancient Indian Knowledge: The Vedas and its components-the Vedangas Ancient Indian books and treaties: The Sastras.; The Great Indian Epics: The Ramayana and The Mahabharata Epics and religious treaties.

Unit III : **Ancient India- Bharat Varsha:** People of Ancient Bharat Varsha; Our great natural heritage: The great Himalayas and the rivers; The civilizations of the Sindhu-Ganga valley, and the Brahmaputra valley; Our coastal plains; Our Nature: Forests and Minerals; Ancient Indian Traditional Knowledge and Wisdom about nature and climate.

Unit IV : **Contribution of Ancient India to Health Sciences:** Traditional Indigenous systems of medicines in India: - Ayurveda and Yoga; Elements of Ayurveda: Gunas and Doshas, Pancha Mahabhuta and Sapta-dhatu; Concept of disease in Ayurveda; Ayurvedic lifestyle practices: Dinacharya and Ritucharya; Important Ayurvedic Texts; Hospitals in Ancient India; Ayurveda: Gift of India to the modern world.

References:

1. Baladev Upadhyaya, Samskrta Śāstrom ka Itihās, Chowkhambha, Varanasi, 2010.
2. D. M. Bose, S. N. Sen and B. V. Subbarayappa, Eds., A Concise History of Science in India, 2nd Ed., Universities Press, Hyderabad, 2010.
3. Astāngahrdaya, Vol. I, Sūtrasthāna and Śarīrasthāna, Translated by K. R. Srikantha Murthy, Vol. I, Krishnadas Academy, Varanasi, 1991.
4. Dharampal, The Beautiful Tree: Indian Indigenous Education in the Eighteenth Century, Dharampal Classics Series, Rashtrotthana Sahitya, Bengaluru, 2021.
5. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavan RN. (2022), Introduction to Indian Knowledge System: Concepts and Applications. PHI Learning Private Ltd.

6. Mukul Chandra Bora, Foundations of Bharatiya Knowledge System. Khanna Book Publishing
7. D. M. Bose, S. N. Sen and B. V. Subbarayappa, Eds., A Concise History of Science in India, 2nd Ed., Universities Press, Hyderabad, 2010.

Course outcomes:

- Classify the key concepts of Indian Knowledge System and discuss the multi-faceted nature of knowledge contained in the Traditional Systems of India.
- Identify the importance of Yoga way of living in maintaining a sound physical, emotional and mental health.
- Recognize the relevance of Arthashastra in public administration and effective governance.

SEMESTER-II

ENS- 201:: 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 Wiederrcht. 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

ENS. 202 (A) :: ENVIRONMENTAL LAW AND SUSTAINABLE DEVELOPMENT

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

National Environmental Policy (NEP, 2000) – Goals and Objectives, Environmental Policy Strategies in Pollution Control, National Policy on Climate Change and International Convention on climate change - UNFCCC, IPCC reports. Global Warming Potential.

UNIT -II

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 - III

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.

UNIT – IV

Sustainable Development: Definition and concept. The emergence Conceptualization of the notion of sustainable development, The Time line calendar of sustainable development, Key aspects and Strategies for Sustainable Development. Guidelines to Campaign for Sustainable Society.

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).
6. Environmental Economics in Theory and Practice. Hanley, Nick, Jason F. Shogren an Ben White. (1997) Macmillan New Delhi, India.
7. Handbook of Natural Resource and Energy Economics. Allen V. Kneese and James L. Sweeney. (1985) North Holland.
8. Environmental Economics: An Introduction. Field B. C (1994) McGraw.
9. Environmental Economics: Theory and applications. Katar Singh and Anil Shishodia, (2007) Sage Publications India Pvt. Ltd.

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

ENS- 202 (B):: NATURAL DISASTERS 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

ENS. 203 (A) :: BIODIVERSITY AND CONSERVATION

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

ENS. 203 (B) :: 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

ENS- 204. PRACTICAL-III

ENS-202- Environmental Law and Sustainable Development
&
ENS-203- Biodiversity and Conservation

1. Impact of artificial intelligence and machine learning on Environmental decision making.
2. Legal challenges in regulating emerging technologies and their Environmental impact.
3. Legal challenges in balancing agriculture and conservation on agricultural lands.
4. Diversity measures: Shannon Wiener, Simpson and Brillion's Index.
5. Diversity measures of Birds fauna in different habitat conditions.
6. Conservation of wetlands.

ENS. 205 (A) :: WASTE WATER TREATMENT AND MANAGEMENT
(Skill Oriented Course)

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 sewage water and apply the knowledge of laws for handling of various sewage water and management.
- To understand the reduction of environmental pollution by management of sludge disposal.

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.

UNIT-II

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 – III

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 –

UNIT – IV

Sludge characteristics, unit operation in sludge disposal, conventional and high rate digester – Disposal of sludge – Gas 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 wastewater management and the laws governing it.
- Discuss the wastewater treatment, route optimization techniques and processing of industrial wastewater.
- Explain the sewage water treatment through natural and artificial methods will be achieved.
- Evaluating the disposal of sludge management practices.

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

ENS. 205 (B):: BIOSTATISTICS AND COMPUTER APPICATIONS
(Skill Oriented Course)

Course objectives

- To understand the applications of statistical techniques to scientific research in health-related fields.
- To describe the variations of two variables.
- To understand the computer communication skills.
- To acquire knowledge by using operating systems.

UNIT-I

Fundamentals of Statistics: Collection of data, Classification and Tabulation, diagrammatic representation. Measures of central tendency-Mean, Median, Mode, Normal distribution, Skewness, Kurtosis, Measures of Dispersion – Standard deviation, standard error. Statistical hypothesis, Null hypothesis, level of significance,

UNIT-II

Statistical analysis: Statistical tests-Z, t, Chi-square, Contingency test, One-way analysis of variance, Correlation and Regression. Environmental models-Lotka-voltera model, Guassian air pollution model.

UNIT – III

Computer Applications: Components of computers; use of computers in Environmental Sciences-Accessories of Computers- Fundamentals of Data Operating Systems

UNIT – IV

Introduction to environmental system analysis; Approaches to development of models; linear simple and multiple regression models, validation and forecasting.

REFERENCES:

1. Statistical Methods. Gupta S. P (1996) Sultan Chand & Sons Publications. New Delhi.
2. Instrumental Methods of Chemical Analysis, Ewing G. W., (1985) 5th Edition McGraw Hill, U. K.
3. Fundamentals of Bio-Statistics. Khan I. A and Kanum A (1994) Ukaaz Publication, Hyderabad.
4. Business Mathematics and Statistics. Vittal R. R (1986) Murgham Publications.
5. Statistics for people who hate statistics. Neil J Salkind (2000) Sage Publications. Inc. New Delhi.
6. Introduction to Bio-Statistics. Gurumani (2005) MJP Publications, Chennai.
7. Peter Norton, Introduction to Computers, Tata McGraw Hill (1998).
8. Alexis Leon and Mathews Leon, Fundamentals of Information Technology, Leon Tech World, Chennai (2001).
9. Rajaraman V, Fundamentals of Computers, Prentice Hall of India (2000).

Course outcomes

- Analyze data using standard statistical techniques in biological samples.
- Utilize the Internet resources for evaluate on-line e-business system.
- Achieve knowledge in computer based analysis in Environmental samples.
- Able to develop computer based models 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-206 (A) :: REMOTE SENVING AND GIS
(Skill Oriented Course)

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

ENS. 206 (B) :: WATER RESOURCES AND WATERSHED MANAGEMENT
(Skill Oriented Course)

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

ENS-207. PRACTICAL –IV

ENS-205-Waste Water treatment and Management
&
ENS-206- Remote Sensing and GIS

1. Determination of pH, TDS, COD and Alkalinity/Acidity
2. Determination of heavy metals in wastewater sample.

3. Estimation of organic chemicals in wastewater sample.
4. Interpretation of drainage characteristics from aerial photographs.
5. Geo morphological Characters Appreciation from aerial photos.
6. Watershed development from aerial photos.

ENV-208. (OOTC). Open Online Transdisciplinary Course – 1

Audit Course
ENS- 209 - Indian Knowledge Systems – 2

Course objectives:

- To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the importance of roots of Indian Knowledge System.
- To help student to understand the knowledge, art and creative practices, skills and values in ancient Indian system.
- To make students acquaint with the facets of traditional knowledge& their relevance and help them be able to apply it to their day to day life.

Unit I : **Diversity and Indian Culture:** Diversity and Indian Culture; Indigenous Faith and Religion; Preservation of culture and indigenous knowledge .

Unit II : **Indian Calendar:** Panchanga. Adhikamasas. Solar and Luni-Solar systems.Solar and Lunar Eclipses Angular diameters of the Sun, Moon and Earth's shadow. Possibility of eclipses. Finding the middle of an eclipse by iteration. Amount of obscuration at any time.

Unit III : **Indian Architecture and Town Planning**: Introduction ancient Indian architecture; Sthapatya-Veda: An Introduction; Indigenous tools & techniques for town planning & Temple Architecture. Lothal, Mohan Jo Daro; Temple Art: Lepakshi Temple, Jagannath Puri Temple, Konark Sun Temple.

Unit IV : **Indian Agriculture:** Significance in Human Civilization; Sustainable Agriculture; Historical significance of agriculture and sustainable farming in India; Step Cultivation of India: Special reference to Northeast India; Wet rice cultivation of Assam.

References:

1. Baladev Upadhyaya, Samskrta Śāstrom ka Itihās, Chowkhambha, Varanasi, 2010.
2. D. M. Bose, S. N. Sen and B. V. Subbarayappa, Eds., A Concise History of Science in India, 2nd Ed., Universities Press, Hyderabad, 2010.

3. Astāngahrdaya, Vol. I, Sūtrasthāna and Śarīrasthāna, Translated by K. R. Srikantha Murthy, Vol. I, Krishnadas Academy, Varanasi, 1991.
4. Dharampal, The Beautiful Tree: Indian Indigenous Education in the Eighteenth Century, Dharampal Classics Series, Rashtrotthana Sahitya, Bengaluru, 2021.
5. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavan RN. (2022), Introduction to Indian Knowledge System: Concepts and Applications. PHI Learning Private Ltd.
6. Mukul Chandra Bora, Foundations of Bharatiya Knowledge System. Khanna Book Publishing
7. D. M. Bose, S. N. Sen and B. V. Subbarayappa, Eds., A Concise History of Science in India, 2nd Ed., Universities Press, Hyderabad, 2010.
8. Textbook on The Knowledge System of Bhārata by Bhag Chand Chauhan, M. S. Sriram, Man and the Universe- An elementary account of Indian Astronomy,(Unpublished 1993).

Course outcomes:

- At the end of the course, students will be able to gain insights into the concept of traditional knowledge and its relevance.
- They will also be able to understand and connect up the basics of Indian traditional knowledge with modern perspective.
- Apply traditional knowledge for sustainability

SEMESTER-III

ENS. 301 :: ENVIRONMENTAL SAFETY

Course objectives

- To understand control the pollutants released into the environment by human activities.
- To identify the various factors that can lead to leaks, spills and releases and their potential dangers to worker safety and environmental protection.
- To inculcate the equitable use of natural resources into a sustainable way for human existence.
- To gain knowledge in understanding of Government and NGO role for protection of environment.

UNIT-I

Scope and Importance; need for public awareness about our Environment; Economic and social security; Environment impact of transportation and Mining. Environmental impact assessment (EIA) -purpose, procedure and benefits of EIA; Biodiversity and its conservation; Sustainable development. Global warming and greenhouse effect, urbanization, acid rain, ozone layer depletion, nuclear accident and holocaust.

UNIT– II

Case studies, population explosion, family welfare programmers-HIV/AIDS, women and child welfare, Environmental pollution — causes, Effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution and nuclear hazards, Solid waste management-urban and industrial waste-causes, effects and control measures.

UNIT-III

Renewable and non-renewable natural resources — Forest resource, Water resource, Mineral wealth / resource, Food resource, Energy resources, Growing energy needs, renewable and non-renewable energy sources, Use of alternate energy sources, Land resource and land degradation, Role of an individual in conservation of natural resources, equitable use of resources for sustainable life styles.

UNIT-IV

Role of Government in Environment protection, legal aspects of Environment protection, NGO initialization, National Committee on Environmental Planning (NCP), Environmental Appraisal Committee (EAC), central and state boards for prevention and control of pollution, goals of Environment impact policy, case studies, Disaster management floods, earth quake, cyclone, landslides, role of individual in prevention of pollution.

REFERENCES:

1. Benny Joseph (2005) Environmental Studies — Tata McGraw Hill - Publishers.
2. Rao CS (2006) - Environmental Pollution Control — New Age International Pvt. Ltd Publishers.
3. ManjunathD..L (2007) - Environmental Studies - Pearson Education Publishers.

4. Yaji R.K (2006) - Text Book of Environmental Studies - United Publishers.
5. Centre for Environmental Education (1990) - Essential learning's in Environmental education.
6. Venugopal Rao P (2006) - Principles of Environmental Science and Engineering —Prentice Hall.

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

ENS. 302 (A) :: 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.
- 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

ENS. 302 (B) :: ENVIRONMENTAL EDUCATION

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

ENS. 303 (A) :: ENVIRONMENTAL IMPACT ASSESSMENT, AUDIT AND REGULATIONS

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

Article 48 A & 58 A, Power and Functions of Central and State Pollution Control Boards to safeguard Environment. Case studies: Land Clearing Projects – Urban localities Dam sites – EIA for Hydel, Thermal, Nuclear, Mining Projects– Highways Projects.

UNIT – III

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 – IV

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

REFERENCES:

1. Environmental Impact Assessment. Canter L. W., (1996) Mc Graw Hill, New York.
2. Environmental Impact Statements. Bregman J.I., (1999) Lewis Publishers, London.

3. Singleton R, Castle P and Sort D, Environmental Assessment, Thomas Telford Publishing, London (1999).
1. Environmental Impact Assessment – A Comprehensive Guide to project and Strategic Planning. Eccleston C. H., (2000) John Wiley and Sons.

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 (A) :: ENS. 303 (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

ENS- 304. PRACTICALS- V

ENS-302- Environmental Chemistry
&
ENS-303- Environmental Impact Assessment, Audit and Regulations

1. Estimation of trace heavy metals in soil, plant and animal material.
2. Estimation of sulphates, phosphates, nitrates and chlorides in water sample.
3. Determination of chromium and zinc by Spectrophotometry.
4. Preparation of Activity-processes Flow Diagrams.
5. Case Study analysis for EIA of a major industry.
6. Case Study analysis for EIA of a Reservoir/Land Conversion/Mining activity.

ENS. 305. (A):: 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

ENS. 305 (B) : GREEN TECHNOLOGIES

Course objectives

- Understand and explain general ways to save energy at a personal, community and global level.
- To achieve and maintain optimum energy procurement and utilization.
- To preserve the environment and natural resources through applications of green techniques.
- To make pollution free earth and educate the people for plantation the trees and about protection the environment.

UNIT-1. Introduction – renewable energy sources, non-renewable energy sources, non-conventional and inexhaustible energy resources. Geothermal energy, wind driven power station, Tidal power plants, Glacier power plants, solar energy, nuclear energy, natural radio activity, nuclear power plant, fast breeder reactors, nuclear fusion, gobar gas.

UNIT-II. Energy management – solar energy input, conventional fuels – oil, coal, natural gas, uranium, risk of nuclear accidents, bio energy – biomass and bio fuels, biogas- biogas technology, petro plants, energy plantations and crops. Waste as renewable sources of energy- types of wastes, classification based on chemical nature and physical state, composition of the waste, conversion of methane into synthetic gas, factors affecting methane formation.

UNIT-III. Green Technology: Phyto-remediation- Hyperaccumulators- biotic interactions, biofilm, Green chemistry-introduction- inception and evolution- importance of solvents- types of catalysts and their role- Biological alternatives- applications. Principles of green chemistry, advances in green chemistry.

UNIT-IV. Green buildings, energy conservation in buildings, materials for green buildings waste management in buildings, essential components in Green building. Application in relation to Environment protection.

REFERENCES:

1. Rashmi Sanghi and Srivasta M.M., Green Chemistry, Narosa (2006).
2. Stanley E Manahan, Environmental Chemistry, Lewis Publications (2001).
3. Sharma, B.K. Kaur H., Environmental Chemistry, Goel, publishing House (1995).
4. Tyagi O.D and Mehra M, Text book of Environmental Chemistry, Anmol publications (1990).

Course outcomes

- Understand of renewable energy systems, its components and interactions between the components.
- Understand, analyze and communicate energy management at global level.
- Develop cleaner production and treatment mechanims for pollution prevention.
- Reduce the environmental impact by using fewer natural resources and develop green skill set, including knowledge about sustainability themes and responsible attitudes towards the environment.

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

ENS. 306 (A) :: ENVIRONMENTAL ENGINEERING

Course objectives

- To reduce the impure residuals of the water and to make it accessible for drinking.
- To remove unwanted constituents in the water and to make it safe to drink or fit for a specific purpose in industry or medical applications..
- To develop appropriate techniques for controlling environmental pollution.
- To demonstrate the importance of air for human health by defining its characteristics and main dangerous pollutants.

UNIT – I

Design of Pressure Pipes, Pump types, Characteristic curves, General layout of Water Treatment Plant – Aerators – Types, Flash Mixer – Design – Clari–flocculator– Filtration – Rapid sand filter and Pressure sand filter design – chlorine demand, residual chlorine and chlorine dosage, Role of Ozone and UV as a Disinfectant.

UNIT – II

Primary and Secondary Settling Tanks – Activated Sludge Process – Types and modifications – Design of Aeration Tanks and Oxidation Ditch – Diffusers and Mechanical Aerators, Tricking Filters and their Design. Duncan Mara Systems (Waste Stabilization Ponds).

UNIT – III

Sludge Processing and Disposal Methods – Design of Anaerobic Digester and Sludge Drying Bed – Reverse Osmosis – Ion Exchange – Incinerators, Land filling – Composting, Vermicomposting, Fly ash utilization, Case studies: Dyeing, Paper and Pulp, Distillery, Thermal, Tannery.

UNIT – IV

Air Pollution Control - Minimum Stack Height – Plume Rise, Design of Settling Chamber, Cyclones, Fabric filters and Electrostatic Precipitators. Scrubber, Exhaust.

REFERENCES:

1. Introduction to Environmental Engineering and Science. Gilbert M. Masters (2004). Prentice – Hall of India Pvt. Ltd., New Delhi.
2. Wastewater Treatment. Rao M. N. and Datta, A. K (1987). Oxford & IBH Publishing Company, Pvt. Ltd., New Delhi.
3. Environmental Engineering. Mackenzie L. Davis and David A. Cornwell (1991). Mc Graw Hill International Editions, New York.
4. Water and Wastewater Technology. Hammer M. J and Hammer Jr. M. J (2001). Prentice – Hall of India Pvt. Ltd., New Delhi.
5. Wastewater Engineering: Treatment and Reuse. Metcalf and Eddy (2003). Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
6. Sewage Disposal and Air Pollution Engineering. Garg. S. K (1990) Khanna Publishers, India.
7. Advances in Industrial Wastewater Treatment. Goel P. K and Sharma K. P (1999). Technoscience Publications, Jaipur, India.
8. Chemistry for Environmental Engineering and Science. Sawyer C. N., Mc Carty P. L., and Parkin, G. F (2003) Tata McGraw – Hill Publishing Company Ltd., New Delhi.
9. Environmental Pollution Control Engineering, C. S. Rao, (2006) New age International Publishers.

Course outcomes

- Describe the removal of contaminants from wastewater and explain the reuse water into a useful manner.
- Illustrate the control of pollution by wastewater treatment practices.
- Able to explain the importance and need of wastewater treatment practices..
- Able to explain the general principles, methods and processes involved in controlling air pollution and aerosol particles.

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

ENS. 306 (B) :: NUCLEAR AND BIOMEDICAL WASTE MANAGEMENT

Course objectives

- To deal radioactive waste in a manner that protects human health and the environment, now and in the future without burdening future generations.
- To deal radioactive waste in a manner that protects human health and the environment, now and in the future without burdening future generations.
- To identify and classify health hazards of biomedical waste.
- To understand the scope of electronics usage in the world and its management.

UNIT-1

Nuclear wastes – composition, Decay, scenario of nuclear wastes in the soil, nuclear fuel cycle, Nuclear energy, Management techniques-simple and high level nuclear waste management – Geological disposal. National and International management plans.

UNIT- II

Introduction, quality of hospital waste, sources of biomedical waste, classification and sources, pathological wastes, sharp pharmaceutical wastes, Genetonic wastes, Chemical wastes, waste contaminated with heavy metals.

UNIT-III

Measures to reduce biomedical wastes, Treatment of hazardous biomedical wastes, Biomedical waste management in developed countries and in India – legal aspects.

UNIT-IV

E-waste, composition, sources. E-waste management in global and national scenario, Recycling and disposal strategies.

REFERENCES :

1. Radiation and Man – Jain H.C. National Book Trust, New Delhi
2. Environmental Radioactivity from Natural, Industrial and Military sources, Merril Eisenbud and Thomas Gessell Academic Press, London.
3. Hazardous wastes and solid wastes / Lie DHF and Liptak B.G (2000), Lewis Publishers, New York.
4. Hazardous waste Management, II Ed, La Grega M.D., Buckingham P.L. and Evan J.C MC Graw Hill Int. (2001).

Course outcomes

- Sustainable nuclear waste management practices can be created economic and social benefits.
- Illustrate the control of pollution by wastewater treatment practices.
- Able to understand handle and safe disposal of biomedical waste.
- Describe consequences of electronic waste for humans and the environment.

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

ENS- 307. PRACTICAL –VI

ENS. 305- Statistics, Computer Applications and Modeling
&
ENS.306- Environmental Engineering

1. Calculation of mean, meridian and mode.
2. MS. Word, MS. Excel, MS. Power Point.
3. Calculation of Latitudes and Longitudes of given places.
4. Demarcation of land / Land Cover/ Forest cover.
5. Water shed/ Drainage basin, paleochannels.
6. Enumeration of local food plants, Medicinal plants.
7. Enumeration of local endemic and endangered species.

ENV-308. (OOTC). Open Online Transdisciplinary Course – II

SEMESTER-IV

ENS-401 :: OOSDC- OPEN ONLINE SKILL DEVELOPMENT COURSE

PW- ENS- 402. PROJECT WORK

Course objectives:

- Evaluate a problem definition.
- Determine how to collect information to determine requirements
- Perform and evaluate feasibility studies like cost-benefit analysis, technical feasibility, time feasibility and Operational feasibility for the project.
- Work on data collection methods for fact-finding
- Construct and evaluate data flow diagrams and logical and physical design requirements.
- Design and evaluate system outputs and inputs.

Unit I : Project work. Definition of project and project work. Project work based on internship, in the study area project work based on Methodology of study area- Water quality analysis Effluent –treatment - Wastewater treatment - Solid waste management- Biomedical waste management- Environmental Impact Assessment. Study of relevant project works of the research project area.

Unit II : Objectives of Project. Effective objectives. specific, measurable, Attainable relevant Time bound Learning. Reflect on important skills for students to development choose an action verb, ABCD method,
Technical Objectives. Network capabilities, hard ware and software Performance objectives. Project Plan, budget prediction, project process report, Team members task Business Objectives, Financial Objectives, effectiveness, Regularity technical Knowledge quality of the work.

Unit III : Project Design. Basic modules, Data design, schema design, data integrity and constrains, Procedural Design, logic diagrams, data structures, Algorithm design user interface design, Project work related software usage and new tools created to the project work. Suitable quantitative methods using for analysis of project work data of study area.

Unit IV : Project work Implementation. Primary. Secondary and field Data collection of the project thrust area Data storage of a research area in specific duration. Preparation of tables, diagrams interpretation of images analysis, map analysis and models preparation of decision support. Findings, results summary of project work .applications and uses of project for community development and reporting of project.

References:

1. Kennett, B. (2014). Planning and managing scientific research. ANU Press. https://www.jstor.org/stable/j.ctt6wp816 (free access)
2. Singh, H. (2014). Mastering Project Human Resource Management: Effectively Organize and Communicate with All Project Stakeholders. FT Press.
3. Andersen, J., Toom, K., Poli, S., & Miller, P. F. (2017). Research Management: Europe and Beyond. Academic Press.
4. Wingate, L. M. (2014). Project management for research and development: guiding innovation for positive R&D outcomes. CRC press.
5. Sirotinina, N. (2012). History and methodology of computer science. Siberian Federal University. Tomsk: TPU Publishing House.

Course output:

Students get knowledge of the project work

- Students can capable for t do projects in future
- Students can create own tools for design to solving research problems.
- Students get experience on using technology.

MODEL QUESTION PAPER
M.Sc. DEGREE EXAMINATION
FIRST SEMESTER
Branch - Environmental Science
Paper-I-ENS.101: ECOLOGY AND ENVIRONMENT

Time: 3 hours **Max. Marks: 70**

PART- A

Answer any FOUR questions. Each question carries 5 Marks (Marks: 4x5=20)

1. Give a brief account on sustainable development.
2. Discuss the importance of biological cycles.
3. Discuss briefly on human population control methods.
4. Explain in brief about the population and community.
5. Classify the types of ecological pyramids of energy flows.
6. What are the food chains and food webs of ecosystem?
7. Give a brief note on the Nitrogen Fixing bacteria.
8. Discuss briefly on maintenance of Eco-balance.

PART-B

Answer ALL questions .Each question carries 12½ marks. (Marks: 4x12½=50)

9. (a) Define Ecology? Explain Man and Environment Relationships.

Or

(b)Explain the scope and importance of Environmental science.

10. (a) Give an account on Human Population growth effect on Environment.

Or

(b) Explain Liebig's law of minimum and Shelford's law of tolerance

.

11. (a) Write on the structure, components and functions of an ecosystem.

Or

(b) Explain the concepts of ecological Niche and classify various types of Niches.

12. (a) What are biogeochemical cycles and explain their importance role in Environment?

Or

(b) Discuss on ecological aspects and their importance for eco-balance maintenance.

MODEL QUESTION PAPER
M.Sc. DEGREE EXAMINATION
FIRST SEMESTER
Branch - Environmental Science
Paper-II-ENS.102 (A) : ENVIRONMENTAL TOXICOLOGY AND PUBLIC HEALTH

Time: 3 hours **Max. Marks: 50**

PART- A

Answer any FOUR questions. Each question carries 2½ Marks (Marks: 4x2½=10)

1. Discuss the mechanism involved in ozone depletion.
2. Illustrate the impacts of acid rain.
3. Write briefly on the impacts toxic chemicals in the Environment.
4. Discuss the role of bio-transformations in pollution control.
5. Comment on the role of bio-indicators.
6. Biodegradation and its role in pollution monitoring.
7. Impacts of eutrophication on aquatic system.
8. Write briefly on bio-remediation.

PART-B

Answer ALL questions .Each question carries 10 marks. (Marks: 4x10=40)

9. (a) Write about various chemical reactions and role in the production of secondary pollutants in the atmosphere.

Or

(b) Explain the process of global warming and its effects on troposphere.

10. (a) Illustrate the biochemical aspects As, Cd, Pb and PAN in atmosphere.

Or

(b) Discuss in biotransformation of oranochlorine pesticides.

11. (a) Write about micro and macro nutrients in the soils.

Or

(b) Illustrate the effects of non-degradable wastes on the Environment.

12. (a) Discuss the types catalysts and their role in green chemistry.

Or

(b) Write different types of reaction in various water bodies including marine Environment.