



Department of Environmental Sciences
Integral University, Lucknow

Effective from Session: 2025-2026							
Course Code	B150806T/ ES523	Title of the Course	EIA & Environmental Policies	L	T	P	C
Year	2nd	Semester	III	3	0	0	3
Pre-Requisite	Basic in Science	Co-requisite					
Course Objectives	The purpose of this course is to impart basic and key knowledge of Environmental Impact Assessment. This will help in enhancing knowledge of the Environmental Impact Assessment process, legislations, Environmental clearance procedure for Projects, Environmental Impact Assessment methodologies, policies, Environmental Auditing, monitoring and ISO standards and gaining practical knowledge through Case studies. After successfully completing of course, the student will able to explore subject into their respective dimensions.						
Course Outcomes							
CO1	Identify the fundamental concepts, principles, process, and environmental clearance procedures of Environmental Impact Assessment (EIA).						
CO2	Explain the principles, stages, and significance of Environmental Impact Assessment and its methodologies.						
CO3	Apply Environmental Impact Assessment methodologies for the assessment of developmental projects.						
CO4	Analyze the significance of EIA tools and techniques for environmental impact prediction and decision-making.						
CO5	Evaluate the effectiveness of Environmental Auditing, Environmental Monitoring, ISO standards, environmental policies, and EIA case studies in environmental management.						

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction and Background	EIA, Requirement of EIA in India, scope and purpose of EIA; EIA process, Salient features of EIA legislation and other statutory obligations, Environmental decision making in India: Environmental clearance procedures and national requirements.	8	CO1
2	Methods & Assessment Framework	Introduction to various impact assessment methods: checklist, matrices, networks, indices and weight scaling techniques; Methodological approaches and tools for key stages in EIA process: Screening (stage to determine the level of EIA, exclusion and inclusion criteria of projects, different approaches to screening) Scoping (scoping steps, guidance and tools, and stakeholder involvement), Impact prediction and evaluation (approach for baseline development and methods of impact identification-checklists, Matrices, Networks)	8	CO2
3	Tools For EIA	Impact assessment methods: scope and limitations, Prediction and assessment of impact on the land, air, water, noise, biological and socioeconomic environments Mitigation: definitions measures including avoidance, reduction, rectification and compensation approaches, principles and concepts of offsets, type of offsets.	8	CO3
4	Environmental Auditing, Monitoring & ISO Standards	Objectives and usefulness of Auditing, Attributes of an auditor and psychology of auditing, monitoring; EIA Types (monitoring, Baseline monitoring, Compliance monitoring; Mitigation monitoring), Ex ante and Post ante EIAs, introduction to national accreditation scheme, ISO 9001, EMS and its benefits, ISO 14001, explanation of PDCA cycle	8	CO4
5	Environmental Policies	Indian Constitutional Provisions Towards the Environment: Article 48A, Article 51A; The Wildlife Protection Act, 1972; The Water (Prevention and Control of Pollution) Act, 1974; The Water (Prevention and Control of Pollution) Cess Act, 1977; The Air (Prevention and Control of Pollution) Act, 1981; The Forest (Conservation) Act, 1980; Environmental Protection Act, 1986; National Environment Policy, 2006; National Forest Policy, 1988	8	CO5
6	Practical Observation through Case Studies	Case studies of hydropower, Cement industries, and thermal projects.	5	CO5

Reference Books:

1. Bregman JI (1999) Environmental Impact Statements. Lewis Publishers, London
2. Canter LW (1996) Environmental Impact Assessment. Mc Graw Hill, New York.

e-Learning Source:

1. <http://www.fao.org/3/i2802e/i2802e.pdf>
2. <http://www.environmentwb.gov.in/pdf/EIA%20Notification,%202006.pdf>
3. <http://extwprlegs1.fao.org/docs/pdf/ind4656.pdf>
4. <http://awsassets.wwfindia.org/downloads/session>

PO-PSO CO	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2					3	2	2					1		3		1	
CO2	3					2	1	2					2		3		2	
CO3	2					1	2	1					2		3		1	
CO4	2					3	1	2					1		3		1	
CO5	2					3	2	1					1		3		1	

2- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
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Effective from Session:2025-2026							
Course Code	B150807T/ ES524	Title of the Course	Environmental Instrumentation, Monitoring and Statistical Analysis	L	T	P	C
Year	2 nd		III	3	0	0	3
Pre-Requisite	Basic in Science	Co-requisite					
Course Objectives	The aim of this course is to introduce the student to a wide variety of modern analytical techniques and modelling used in environmental science research. The students will adopt correct sampling techniques and methodology. It is designed to couple the theory of equipment operation with a basic understanding of the chemical principles involved.						

Course Outcomes	
CO1	Understanding the basics of the environmental modelling and simulation which can be applied in environmental sciences
CO2	Interpret the importance of environmental sampling methods, standard procedures, accurate analytical techniques, and laboratory quality protocols.
CO3	Explain air, soil, and water quality monitoring methods and the analysis of their key environmental quality parameters.
CO4	Students will be analyze principle and working of wide range of major Instruments involved in environmental parameter analysis.
CO5	Evaluate environmental tools and techniques for their suitability in environmental monitoring and analysis.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to modelling	Introduction: Theory and practice of modelling; System simulation, types of models, modelling steps and ingredients; The modeller's toolkit. Model formulation and implementation: Physical models; Conceptual models; Mathematical models; Simulation models; Mechanistic models; Empirical models	8	CO1
2	Sampling Methods	Sampling Methods for Environmental Parameters- Protocol Development. Indian and International Standards for Air, Soil and Drinking Water Quality. Sample Preparation: Interferences and Detection Limits, Equipment Calibration and maintenance	6	CO2
3	Environmental Monitoring	Monitoring and Analysis of Air for Gaseous Pollutants: e.g. SO _x , NO _x , Monitoring & Analysis of Particulate Pollutants and Odorous Gases. Physico-Chemical and Biological Analysis of drinking and waste water. Monitoring and Analysis of Soil quality parameters: NPK.	8	CO3
4	Basics of Analytical Techniques and Instrumentation	Basic Terminology: Equivalent weight, Molecular weight, Normality, Molarity, Molality, Constant weight, Specific gravity Buffer solution. Precision and accuracy. Theory, Principles, Working operation and application of Colourimetry, Flame photometry, Polarimetry, Spectrophotometry: Atomic Absorption Spectroscopy, Liquid chromatography, Gas chromatography.	8	CO4
5	Gravimetric and Volumetric Methods of Analysis:	Determination of total, dissolved, suspended, volatile and fixed solids, Estimation of moisture content of soil, phytomass, and compost/ vermicompost. Importance of volumetric analysis, Standardization of reagent using volumetric reactions, Acid-base titrimetry,	7	CO4
6	Spectrophotometry Chromatography, Microscopy	Flame photometry, Polarimetry, Spectrophotometry: Atomic Absorption Spectroscopy, Thin Layer Chromatography, Column chromatography Liquid chromatography, Gas chromatography. High performance liquid chromatography, High Performance Thin layer chromatography. Theory, principles working operation and application of Light, Fluorescence Scanning Electron Microscopy, Transmission Electron Microscopy. Staining and Fixation techniques.	8	CO5

Reference Books:	
1) Methods in Environmental Analysis: Water, Soil and Air. PK Gupta	
2) Hand Book of Analytical Instruments 2006 McGraw-Hill Education Private Limited	
3) Physicochemical Parameters of Water and Method of Their Analysis	
4) Handbook of Process Chromatography: A Guide to Optimization, Scale Up, and Validation Gail K. Sofer	
e-Learning Source:	
https://www.standardsmedia.com/Instrumentation-1109-mc.html .	
https://www.nepjol.info/index.php/SW/article/viewFile/2667/2361	

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO																	
CO1	3					2	3	2					1		1		1
CO2	2					3	2	3					1		2		1
CO3	1					2	1	2					1		1		2
CO4	2					3	2	2					1		2		1
CO5	2					2	3	1					2		2		1
													1		1		1

1-Correlation Low Correlation; 2- Moderate Correlation; 3- Substantial

Name & Sign of Program Coordinator	Sign & Seal of HOD
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Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2025-2026

Course Code	B150808T/ ES525	Title of the Course	Remote Sensing and GIS	L	T	P	C
Year	2 nd	Semester	III	3	0	0	3
Pre-Requisite	Basic in Science	Co-requisite					
Course Objectives	This course provides students an understanding of the basic concepts of remote sensing and Geographical Information Systems (GIS) techniques and the applications of these techniques in various branches of environmental sciences. The course is organized into two parts. The first part focuses on the theories underlying basic processes in remote sensing, aerial and satellite remote sensing, photo-grammetry, sensors and digital image processing. Students will be taught processing of satellite images, and how data from various satellite platforms are used in the environmental sciences. The second component of the course focuses on the GIS, where the structure and format of GIS data, data input and transformation, spatial analysis are taught. In addition, students will gain an understanding of the recent advances in GIS such as WebGIS, Open Geospatial Consortium (OGC), and data portals commonly used in remote sensing and GIS.						

Course Outcomes	
CO1	Identify the basic concepts, components, and terminology of remote sensing, aerial photogrammetry, GIS, satellites, and sensors.
CO2	Explain the physical principles of remote sensing, the fundamentals of aerial photogrammetry, image processing techniques, and the functions of different satellites and sensors.
CO3	Apply GIS and remote sensing techniques for environmental mapping, monitoring, and spatial analysis.
CO4	Analyze remotely sensed data and evaluate the suitability of different satellites, sensors, and image processing techniques for environmental applications.
CO5	Evaluate the effectiveness of remote sensing, aerial photogrammetry, GIS, and image processing techniques for environmental assessment and decision-making.

Unit No.	Title of the Unit	1Content of Unit	Contact Hrs.	Mapped CO
1	Basic Concept	Remote Sensing: History, Development, Definition, Concept & Principles, Electromagnetic Radiation (EMR) and Its Characteristics, Wavelength Regions, and their Significance, Interaction of EMR with Atmosphere and Earth's Surface: Absorption, Reflectance and Scattering, Atmospheric Windows, Spectral Response and Spectral Signature, Spectral, Spatial, Temporal and Radiometric resolutions.	7	CO1
2	Photogrammetry	Definition and terms, history of photogrammetry, concepts, principles and types of photogrammetry, elements of image interpretation, classification of aerial photographs, vertical photographs, tilted photographs, orthophotographs, aerial cameras, geometry and scale of photograph, distortions, relief displacements and their corrections, rectification and orthophotos,	7	CO2
3	Remote Sensing Sensors & Satellite	Types of Sensors -Sensors, Platforms and Scanners, Thermal, Multispectral (MSS), Microwave, Lidar, Hyperspectral : Basic definition and principles, general characteristics, spectral resolution and interpretation, applications in environmental monitoring. Satellite Remote Sensing - advantages of satellite remote sensing, types of satellite orbits - polar and geostationary, Satellite characteristics - Orbit, swath, resolution, scale. Overview of satellites – Landsat, SPOT, IRS, NOAA, Cartosat, Oceansat, satellites - their sensors, geometry, radiometry, orbital characteristics, data products and applications.	7	CO3
4	Digital Image Processing	Digital Image Processing - Digital Image formats, file structures, Image Rectification and Restoration, Image enhancement, Image classification – supervised, unsupervised, ground truth data and training set manipulation, data merging.	8	CO4
5	Geographical Information System(GIS)	Geographical Information System (GIS) - definition, historical evolution, components, basic principles. Data models - vector and raster data, spatial and non-spatial data, Map projection, Types of datum, Spatial Analysis, measurements, queries, buffering and neighborhood functions, map overlay, network analysis, spatial interpolation –TIN, DEM, DSM. Advances in GIS – Web GIS, Open Geospatial Consortium (OGC), FOSS in GIS, Data mining, Bhuvan Geoportal.	8	CO5
6	Application of Remote Sensing and GIS	Applications in forestry and wild life management; monitoring of land use/land cover; soil and agriculture; water resources; urban planning; disaster management; health studies.	8	CO5

Reference Books:

1.	Abbassi, Er. T. &Abbassi, S.A. 2010. Remote sensing, GIS and Wetland management, Discovery publishing house, Pvt. Ltd.
2.	Agaral, N.K. 2004. Essentials of GPS, Spatial Networks Pvt. Ltd. Hyderabad.
3.	AnjiReddi, M. 2000. Remote Sensing and geographical Information System.
4.	Lillesand, T. M. and Kiefer, R. W. 1987.Remote Sensing and Image Interpretation. John Wiley and Sons, New York.
5.	Cracknell, A. P. &Varotsos, C. A. 2012.Remote sensing and atmospheric ozone-Human activities versus natural variability, Springer, published in association with Praxis Publishing, Chichetser, UK

e-Learning Source:

1.	www.aboutgis.com
2.	www.bhuvan.nrsc.gov.in
3.	www.surveyofindia.gov.in

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO- PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2					2	1	2							1	1	
CO2	1					1	2	3							1	1	
CO3	2					2	2	2							2	2	
CO4	3					1	1	1							2	2	
CO5	1					2	3	3							2	2	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
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Effective from Session: 2025-2026

Course Code	B150809T/ES526	Title of the Course	Disaster and its Management	L	3	T	0	P	0	C	3
Year	2 nd	Semester	III								
Pre-Requisite	Basic in Science	Co-requisite									
Course Objectives	To introduce the concepts of disaster, hazard, vulnerability, and risk, and their interrelationships, To understand the phases of mitigation, preparedness, response, and recovery in disaster management, To learn planning, early warning systems, and community awareness programs.										

Course Outcomes

CO1	Identify the concepts and definitions of disaster, hazard, vulnerability, risk, and the types of natural, industrial, and technological hazards.
CO2	Explain the interrelationships among disaster, hazard, vulnerability, and risk, and describe the causes, characteristics, and impacts of geological, industrial, and technological hazards on human life and the environment.
CO3	Apply structural and non-structural mitigation measures and emergency response procedures for disaster risk reduction in different hazard scenarios.
CO4	Analyze the causes, impacts, and risk factors associated with geological, industrial, and technological disasters, and differentiate appropriate mitigation and response strategies.
CO5	Evaluate the effectiveness of disaster mitigation measures, emergency response systems, and Incident Command Structures in managing and reducing disaster risks.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.
1	Fundamentals of Disasters	Concept and definition of disaster, hazard, vulnerability, and risk, Classification of disasters: natural, man-made, and hybrid, Disaster cycle: mitigation, preparedness, response, and recovery, Historical perspectives and case studies of major disasters	5
2	Science of Natural Hazards	Geological hazards: earthquakes, tsunamis, volcanoes, landslides, Hydrological hazards: floods, cyclones, droughts, Biological hazards: epidemics, pandemics, pest infestations, Environmental impacts and socio-economic consequences	8
3	Anthropogenic and Emerging Hazards	Industrial and technological hazards: chemical spills, nuclear accidents, dam failures, Urban hazards: fire, building collapse, transportation accidents, Environmental degradation: deforestation, desertification, climate change, Case studies: Bhopal Gas Tragedy, Chernobyl, Fukushima	8
4	Disaster Preparedness and Mitigation	Risk assessment and vulnerability analysis, Early warning systems and forecasting technologies, Structural and non-structural mitigation measures, Community-based disaster risk reduction (CBDRR), Role of education, awareness, and capacity building	8
5	Disaster Response and Recovery	Emergency response systems and incident command structures, Search, rescue, and relief operations, Rehabilitation and reconstruction strategies, Psychological and social dimensions of disaster recovery, Role of NGOs, civil society, and international organizations	8
6	Policy, Governance, and Future Directions	National Disaster Management Authority (NDMA) and international frameworks (Sendai Framework, UNDRR), Disaster management policies, laws, and institutional mechanisms, Integration of disaster management into development planning, Emerging challenges: climate change, urbanization, cyber hazards, Research, innovation, and future trends in disaster resilience	8

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2					2	2	2							1		
CO2	2					2	2	1							1		
CO3	2					2	1	2							1		
CO4	2					2	3	1							1		
CO5	2					1	2	1							1		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator

Sign & Seal of HoD

Effective from Session: 2025-2026							
Course Code	B150810P/ES527	Title of the Course	Environmental lab III	L	T	P	C
Year	2nd	Semester	III	0	0	4	2
Pre-Requisite	Basic in Science	Co-requisite					
Course Objectives	This course provides students with a working knowledge of aerial photography, water quality parameter, Particular matter analysis.						

Course Outcomes	
CO1	Students will be able to identify the basic concepts of aerial photography.
CO2	Students will be able to explain water and soil quality parameters.
CO3	Students will be able to assess the particulate matter load on roadside plants using quantitative methods.
CO4	Students will be able to analyze the factors contributing to environmental pollution and related problems.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Mapping and Identifying Land Cover Using Aerial Images	Identification of Land cover area by using Aerial Photography	7	CO1
2	Water Quality and Soil Moisture Retention	To study the total dissolved and suspended solids in water and waste water. To determine the water holding capacity of soil.	8	CO 2
3	Quantitative Assessment of Particulate Matter on Foliage Near Roadways	To estimate the amount dust (particulate matter) deposition on the leaves of roadside plants	7	CO3
4	Field visit	Identifying the sources of pollution in water obtained from different sources. Visit to a local area to document environmental assets river/forest/grassland.	8	CO4

Reference Books:	
1. Janick Artiola, Ian Pepper & Mark Brusseau. (2004). <i>Environmental Monitoring and Characterization</i> . Academic Press., 978-0-12-064477-3	
2. Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman; (2022). <i>Remote Sensing and Image Interpretation, 7ed (An Indian Adaptation)</i> . Wiley; ISBN: 9789354642104.	
3. Umesh Kulshrestha, Pallavi Saxena (2016). <i>Plant Responses to Air Pollution</i> . Springer, Science - 195 pages	
4. J. Jeffrey Peirce, P. Aarne Vesilind, Ruth F. Weiner (1997). <i>Environmental Pollution and Control</i> , 4th ed. ISBN: 0750698993; Publisher: Elsevier Science & Technology Books.	
e-Learning Source:	
1. https://youtu.be/UTB4IJOLJ_Y?si=hF13dvtfNmkrqqwV	
2. https://youtu.be/nmXwZAPbcvw?si=u1ERswrSg4f-EJjD	
3. https://youtu.be/FAdALDwM6H0?si=mKaTIRCWx-YARLf6	
4. https://youtu.be/sl1C8YINA5c?si=48OC1a0wo2gmYIdh	

PO-PSO	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3		-	-	-	3	3	3	-	-	-	-	3	-	3	-	-	-
CO2	3		-	-	-	2	2	3	-	-	-	-	3	3	3	-	-	-
CO3	3		-	-	-	3	3	3	-	-	-	-	1	1	-	-	-	-
CO4	1		2	-	-	-	2	3	-	-	-	-	1	2	-	-	3	-

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HOD
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Effective from Session: 2025-2026

Course Code	B150811T/ES528	Title of the Course	Energy Management and Disruptive Technologies	L	3	T	0	P	0	C	3
Year	2 nd	Semester	III								
Pre-Requisite	Basic in Science	Co-requisite									
Course Objectives	To enable the students to understand the concept of energy management and energy management opportunities. To understand the different methods used for the economic analysis of energy projects										

Course Outcomes	
CO1	Understand the basic concepts of energy, environment, and sustainable development.
CO2	Explain the basics of various types of renewable and clean energy technologies.
CO3	Apply appropriate alternative energy resources to address environmental and energy challenges.
CO4	Investigate the role of energy ecosystem management in environmental sustainability
CO5	Evaluate the relationship between energy and the economy.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	Energy: Overview of energy, Energy sources and types of energy and their generation, Renewable & Nonrenewable energy, Conservation of Energy, Overview of energy, World scenario, Indian scenario, Importance of Coal, Petroleum, Oil and Natural Gas and their environmental prospects, New Energy Resources, Socio-economic development, Energy & Environment, Energy & Development, Future Energy System, Clean Energy Technology.	8	CO1
2	Renewable Sources of Energy	Solar Energy: Solar radiation: measurements and prediction. Indian's solar energy potential and challenges, solar energy conversion principles and technologies: Photovoltaic conversion and Photo thermal energy conversion. Wind Energy: Atmospheric circulations, atmospheric boundary layers, classification, factors influencing wind, wind shear, turbulence, wind speed monitoring, Betz limit, wind energy conversion system: classification, characteristics and applications. Ocean Energy: Ocean energy resources-ocean energy conversion principles and technologies: ocean thermal, ocean wave & ocean tide.	8	CO2
3	Energy from wastes	Waste as renewable sources of energy- types of waste, classification based on chemical nature and physical state, composition of the waste, conversion of methane in to synthetic gas, factors effecting methane formation.	6	CO3
4	Alternative Energy Resources	Nuclear Energy: Introduction, Fusion and Fission, chain reactions, a brief account of nuclear reactors. Energy Plantation: Overview of Energy Plantation, Biodiesel Production and Application. Alcohol fuels – bio-ethanol production using advance technology.	7	CO3
5	Energy Management	History of Energy Management, Definition and Objective of Energy Management and its importance. Need of energy management, General Principles of Energy Management, Energy Management Skills, and Energy Management Strategy. Energy Management Approach. Understanding Energy Costs, Benchmarking, Energy performance, Matching energy usage to requirements, Maximizing system efficiency, Optimizing the input energy requirements, Fuel and Energy substitution. Organizing, Initiating and Managing an energy management program. Roles, responsibilities and accountability of Energy Managers.	8	CO4
6	Energy and Economy	Energy and Economics: gross domestic product (GDP) and energy – energy market and society – energy efficiency – energy – energy and economics – energy: security – equity – environmental sustainability index and global measure, Renewable Energy for Sustainable Development. Energy conservation approaches. Economic assessment and sustainable development.	8	CO5

Reference Books:

Energy and Environment Set: Mathematics of Decision Making, Loulou, Richard; Waub, Jean- Philippe; Zaccour, Georges (Eds.), 2005.

Energy and the Environment, Ristinen, Robert A. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A., 2nd Edition, John Wiley, 2006.

References:

- Energy and the Challenge of Sustainability, World Energy assessment, UNDP, N York, 2000.
- Solar Energy: principles of Thermal Collection and Storage, S.P. Sukhatme, Tata McGraw-Hill (1984).
- D. Y. Goswami, F. Kreith and J. F. Kreider, Principles of Solar Engineering, Taylor and Francis, Philadelphia, 2000.
- Geothermal Energy: From Theoretical Models to Exploration and Development by Ingrid Sober and Kurt Bucher, Springer, 2013.
- Ocean Energy: Tide and Tidal Power by R. H. Charlier and Charles W. Finkl, Springer 2010
- Amlan Chakrabarti, Energy Engineering and Management, PHI, Eastern Economy Edition.
- (<http://www.npcindia.gov.in/>)
- (<http://www.em-ea.org/>)
- (<http://www.pcara.org/>)

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3						3						3					
CO2	3						3						3					
CO3	2						2	1					3					
CO4	3						2	1					3		1	1		
CO5	3						3						2		1			

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator

Sign & Seal of HoD

Effective from Session: 2025-2026

Course Code	B150812T/ES529	Title of the Course	Environmental Toxicology and Risk Assessment	L	T	P	C
Year	2nd	Semester	III	3	0	0	3
Pre-Requisite	Basic in Science	Co-requisite					
Course Objectives	To provide students with a basic understanding of how toxic substances affect the environment and human health. The course aims to develop skills in identifying toxicants, understanding their effects, and applying simple risk assessment methods for environmental protection.						

Course Outcomes

CO1	Define the basic concepts, scope, and importance of environmental toxicology and environmental risk assessment.
CO2	Describe the routes through which toxic substances enter the body, their mechanisms of action, and their effects on living organisms.
CO3	Apply the concepts of toxicant transport, bioaccumulation, and transformation to environmental systems.
CO4	Analyze the impact of toxicants on plants, animals, and ecosystems through the interpretation of ecological and toxicological responses.
CO5	Evaluate the impact of environmental pollutants on human health using basic environmental risk assessment methods.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Environmental Toxicology	Meaning and importance of toxicology, Types of toxic substances, toxic chemicals affect living organisms, Basic idea of environmental risk assessment (hazard, exposure, risk)	6	CO1
2	Toxicants and Their Effects	Toxic substances entering the body (air, water, food, skin), body handling toxic chemicals (absorption, distribution, metabolism, excretion), Dose-response relationship (how amount of toxin affects harm), Factors that increase or decrease toxicity	8	CO2
3	Fate and Movement of Toxicants in the Environment	Toxicants spread in air, water, and soil, Bioaccumulation and biomagnification, chemicals in the environment (breakdown, transformation), Simple models used to understand movement of pollutants	8	CO3
4	Ecotoxicology	Effects of toxic substances on plants, animals, and ecosystems, Food-chain contamination, Case studies of environmental pollution (example: Minamata, Bhopal, oil spills), Ecologists assess ecological risk	7	CO4
5	Human Health Toxicology	Common pollutants harmful to humans, Health effects: cancer, nerve damage, reproductive issues, hormonal problems, Human exposure pathways, Basics of human health risk assessment (HQ, RfD, cancer risk), public awareness	8	CO5
6	Laws, Pollution Control & New Concerns	Important environmental laws and agencies (CPCB, MoEFCC, USEPA, WHO), Safety standards for air, water, soil, new pollutants: plastics, microplastics, nanoparticles, pharmaceuticals, Simple introduction to laboratory techniques (GC, HPLC, spectrophotometers) used to detect toxic chemicals.	8	CO5

Reference Books:

1. Anisa Basheer (1995) Environmental Epidemiology, Rawat Publications, New Delhi.
2. Meera Asthana and Astana D.K (1990) Environmental Pollution and Toxicology, Alka Printers, Chandigarh.
3. Sharma PD, Rastogi and Lamporary (1994) Environmental Biology and Toxicology, Rajpal and Sons Publishing, New Delhi. 4-Sood A (1999)

e-Learning Source:

1. https://www.youtube.com/results?search_query=Environmental+Toxicology
2. <https://www.youtube.com/watch?v=RNNjN065y5o>
3. <https://www.youtube.com/watch?v=v4jmPpTcdxQ>

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO - PSO - CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3						2						2					
CO2	2						3						1					
CO3	3						3						1		1			
CO4	3												1					
CO5	3												3	1				

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HOD
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Effective from Session: 2025-2026

Course Code	B150813T/ ES530	Title of the Course	Environmental Planning and Management	L	3	T	0	P	0	C	3
Year	2 nd	Semester	III								
Pre-Requisite	Basic in Science	Co-requisite									
Course Objectives	This course provides an overview of the entire process of Environmental Planning and Management (EPM), including selecting alternatives, implementing and monitoring those alternatives, and providing a better understanding of EPM implementation in different areas.										

Course Outcomes

CO1	Define the core concepts and goals of Environmental Pollution Management (EPM) and recognize the historical and current trends in environmental degradation.
CO2	Describe the technical tools used in environmental planning.
CO3	Demonstrate the application of environmental planning approaches for problem scoping, alternative selection, impact evaluation, and implementation monitoring.
CO4	Analyze the integration of Environmental Management Plans (EMP) in different environmental management areas.
CO5	Assess the effectiveness of strategies for different environmental hazards through case studies.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Environmental Planning and Management	Basic Principles, concepts and scope of Environmental Planning and Management, Historical developments, tools and techniques, Environmental Management Systems (EMS),	6	CO1
2	Tools and techniques in Environmental Planning & Management	Introduction to quality models: Input/output, Linear programming, Risk assessment and environmental modelling, Carrying capacity and land-use planning, Environmental auditing and lifecycle analysis.	8	CO2
3	Implementation, Monitoring, and Assessment	Identifying Issues of Concern; Assessing Plan and Project Impacts; Selecting Environmental Quality Indicators Steps in Environmental planning- Identification and formulation of strategies of EPM Environmental analysis and EPM- Physical planning concerning environmental and land use classification.	8	CO3
4	EPM in areas	EPM for Town and urban lands, Rural and agricultural lands, Waste lands, Wetlands, Mining areas, Industrial areas, Transportation and urban planning	7	CO 4
5	Environmental Planning in Practice (Environmental Hazards)	Environmental hazards in Environmental Planning and Management: Types of environmental hazards- Flood, drought, landslides, earthquakes, cyclones etc., Significance and characteristics of hazards in environmental planning and development, Opportunities and regional planning for hazard management	8	CO4
6	Case Studies	Case studies Designing and evaluating environmental management plans (EMPs).	8	CO5

Reference Books:

1. Environmental Management, Text and Cases, Bala Krishnamoorthy, PHH Publication, 2nd Edition, New Delhi, 2009
2. Environmental Management. Kulkarni, V. and Ramachandra, T.V. Capitol Pub. Co., New Delhi. 2006.
3. The Global Environment in the Twenty-First Century - Prospects for International Co-operation, Chasek, P. S., Indian Reprint by Manas Publications, New Delhi.2004.
4. Introduction to Environmental Management, M.K Theodore & Louis Theodore, CRC Press, Distributors; Ane Books Pvt. Ltd

e-Learning Source:

1. https://energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/G-CEQ-CitizensGuide.pdf
2. <http://onlinelibrary.wiley.com/doi/10.1111/psj.12067/full>
3. <https://doi.org/10.1080/09640560802703256>

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO - PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO																		
CO1	2					3	1						3					
CO2	2						2	2					1	3		2		
CO3	3						2	1							3	2		
CO4	2						2	1						1				
CO5	3						2	1						2				

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
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