Integral University, Lucknow

Effective from Session: 2024-2025							
Course Code	**B150101T/ES125**	**Title of the Course**	**Basics of Environmental Science**	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	I	**3**	**1**	**0**	**4**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	This course provides students with a working knowledge of concept of environment and the relation between human and its relation with the environment.						

Course Outcomes

CO1	Gain knowledge about origin of life and related theories.
CO2	Learn fundamental concept of environmental science.
CO3	Develop the understanding about environmental education and able to understand the relationship between human and environment.
CO4	Understand the concept of sustainable development and SDG and also able to understand the current scenario of environmental degradation.
CO5	Learn the significance and importance of environmental management and have the practical knowledge about the affected areas of environment.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Evolution	Origin of life and speciation, Darwinism and modern synthetic theory of evolution, Natural Selection; Biochemical basis of origin of life; Hardy Weinberg Equilibrium; Genetic drift.	8	CO1
2	Concept of Environment	Definition, Principles and Scope of Environmental Science; Environment, its components and segments; Moral and Aesthetic Nature of Environmental Science; Objectives and Historic roots of the subject; for Public Awareness.	8	CO2
3	Environmental	Goals of environmental education; Environmental Literacy, Environmental Careers, Environmental Justice, Individual Organisms, Environmentalism, Environmental Education at Primary, Secondary level.	6	CO3
4	Man and Environment:	Man-Environment relationships; Impacts of human activity on environment (Agriculture, transportation, mining, urbanization, industrialization); Environmental Degradation and Conservation Issues, Modern concept of environmental conservation	8	CO3
5	Sustainable development	Concept and Significance of sustainable development, Core elements of sustainable development, Over-view of SDG (Sustainable Development Goals).	6	CO4
6	Current Environmental Issues	Ill effects of fireworks and environmental degradation, Climate change and its effects on human health, Deforestation and its impacts on human communities and flora and fauna of the Environment.	8	CO4
7	Environmental Management	Significance of Environment Management, Resettlement and rehabilitation of project affected areas, Environmental ethics: Role of Indian's religions and cultures in environmental conservation, Communication and public awareness programs for environment management.	8	CO5
8	Field Survey	Assessment of impacts of anthropogenic activities in the surrounding environment; Evaluation of the consequences rising from agricultural and commercial logging practices to preserve environment, case study, Reclamation and monitoring of the affected area by developmental activities: case study.	8	CO5

Reference Books:

1. Environmental Science by William P. Cunningham and Mary Ann Cunningham; McGraw-Hill Publications.
2. Environmental Science: Earth as a Living Planet by Botkin and Keller; JOHN WILEY & SONS, INC
3. A text Book of Environment Studies, Asthana, D. K. and Asthana, M. 2006, S. Chand & Co.
4. Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
5. Atmosphere, Weather and Climate, Barry, R. G. 2003, Routledge Press, UK.
6. Environmental Science: S. C. Santra, New Central Book Agency.

e-Learning Source:

1. Environmental Science, Dr. Y. K. Singh, https://www.hzu.edu.in/bed/E%20V%20S.pdf
2. Textbook for Environmental Studies, Erach Bharucha, https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf
3. Fundamentals of Environmental Studies, https://www.jkcprl.ac.in/download/11567250727.pdf

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	2	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	2	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-
CO5	2	1	-	-	-	-	-	-	-	-	-	-	3	2	-	-	-	-

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2024-2025							
Course Code	**B150102P/ES126**	**Title of the Course**	**Practical on Environment**	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	I	**0**	**0**	**4**	**2**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	This course provides students with a working knowledge of Lab practices, environment and its relation with the human being, Meteorological parameters.						

Course Outcomes	
CO1	Students will be able to understand the good Laboratory Practices including Dos & DON'Ts in the laboratory.
CO2	Students will be able to learn interaction of human with environment.
CO3	Students develop understanding about local environmental problems and able to find remedy.
CO4	Gain knowledge about different meteorological parameters.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Good Lab Practices (GLP).	i. Instructions ,ii. DOs and DON'Ts in the Laboratory,iii. General Information,iv. Introduction	8	CO1
2	Environmental Issues and Impacts	Study the effects of environmental problem and its impact on human population.	8	CO2
3	Plants/ Trees and Its Importance	Choose five common species of Trees / plants from your near areas and list their common names.Describe each plant in terms of its height and leaves	8	CO3
4	Weather Parameters measuring Devices	To record the following parameters of weather monitoring station: A. Atmospheric Pressure, B.Rainfall, C.Outdoor, indoor temperature D.Wind speed and Direction E.Humidity & draw point	8	CO4

Reference Books:

Environmental Science: Earth as a Living Planet by Botkin and Keller; JOHN WILEY & SONS, INC.

A text Book of Environment Studies, Asthana, D. K. and Asthana, M. 2006, S. Chand & Co.

Atmosphere, Weather and Climate, Barry, R. G. 2003, Routledge Press, UK.

Environmental Science: S. C. Santra, New Central Book Agency.

e-Learning Source:

1. Good Lab Practices, https://youtu.be/YXl6MLvcGic; https://youtu.be/TADfGsai3Ro.

2.Indian Meteorological Department, Weather, https://mausam.imd.gov.in/imd_latest/weather_video/video.php.

3, Atmospheric Pressure, https://youtu.be/r7ZfzJ-yP3U; https://youtu.be/JQp63iUYSgU.

4. Anemometer, https://youtu.be/cWzGDEDVEgY; https://youtu.be/J5Eh6EU18Us;https://youtu.be/n5deIWQigrk.

5. Rain gauge, https://youtu.be/y6tyAy_MRv0; https://youtu.be/IU9CsbAkRbc.

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

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2024-2025							
Course Code	B150103T/ES127	**Title of the Course**	Environmental Chemicals and Toxicants	**L**	**T**	**P**	**C**
Year	1st	**Semester**	I	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 with Science	**Co-requisite**	None				
Course Objectives	1. To comprehend the basics of environmental chemistry in a precise and compact way. 2. To provide understating of various aspects of chemicals and chemistry, which are particularly valuable to environmental scientific practice. 3. During this course you student will study the chemistry of air, water, and toxic organic compounds. 4. To lay a foundation for understanding in specialized areas of environment management and practices. 5. To provide student with an understanding of the fundamental chemical processes that are central to important environmental problems.						

Course Outcomes	
CO1	Identify and evaluate the relative importance of various reactions, physical processes and transport mechanisms affecting different chemicals in the environment.
CO2	Apply quantitative problem-solving skills to questions in environmental chemistry.
CO3	Compare/contrast the composition and temperature profile as well as predominant types of reactions in different regions of the atmosphere.
CO4	Creating models to predict consequences for the environment.
CO5	To use chemistry knowledge to find the most suitable measures, management methods and industrial solutions to ensure a sustainable use of the earth's resources and ecosystem service.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Fundamentals of Environmental Chemistry	Fundamental Concept & Scope of environmental chemistry, stoichiometry, Gibb's energy, chemical potential, chemical equilibria, acid base reactions.	**8**	**CO1**
2	General Principles of Environmental Chemistry	Pollutant, Contaminant, Receptor, Sink, pathways of Pollutant, Speciation, Dissolved Oxygen, Chemical Oxygen Demand, Biological Oxygen Demand, Threshold Limit Value, Elementary Idea on carbohydrates, Proteins & lipids.	**6**	**CO2**
3	Chemical Accidents	Bhopal gas tragedy (India), Love Canal tragedy (USA) etc.	**6**	**CO2**
4	Atmospheric Chemistry	Composition of Atmosphere, Particles, Ions and Radicals in the atmosphere, Chemical Processes for Formation of Inorganic Particulate Matter, Chemical Processes for formation of Organic Particulate matter, Chemical & Photochemical Reactions in the atmosphere.	**8**	**CO3**
5	Aquatic Chemistry	Properties of water, chemistry of water, concept of DO, BOD, COD, sedimentation, coagulation, filtration.	**8**	**CO4**
6	Soil Chemistry	Composition of Lithosphere/soil, water and air in soil, Inorganic and organic components in soil, Micro and Macro nutrients, Nitrogen Pathways and NPK in Soil.	**8**	**CO4**
7	Environmental Chemistry	Toxic chemicals in the environment, Impact of Toxic chemicals on Enzymes, Biochemical effects of Arsenic, Biochemical effects of Cadmium, Biochemical effects of lead, Biochemical effects of Mercury, Biochemical effects of Carbon Monoxides, Biochemical effects of Pesticides.	**8**	**CO5**
8	Green Chemistry for Sustainable Future	Reagents, Media, Special Importance of Solvents, Water the Greenest Solvents, Synthetic and Processing Pathways, Role of Catalyst, Biological Alternatives, Biopolymers, Principles and Application of Green Chemistry, Zero waste technology.	**8**	**CO5**

Reference Books:

1. Baird and Colin "Environmental Chemistry"
2. Bailey, Clark , Ferris, Krause and Strong "Chemistry of Environment"
3. Manahan, Stanley E. Fundamentals of Environmental Chemistry Boca Raton: CRC Press LLC,200

e-Learning Source:

1- https://www.futurelearn.com/courses/atmospheric-chemistry-planets-and-life-beyond-earth

2- https://inside.mines.edu/~epoeter/_GW/17WaterChem1/WaterChem1pdf.pdf

3- https://www.studocu.com/row/document/university-of-eldoret/soil-chemistry/soil-chemistry-notes-2nd-part/2253260

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	PSO6	PSO7
CO1	2	1	1	1		2							2	2	2			
CO2	2	1	1	1		2							2	2	2			
CO3	2	1	1	1		2							2	2	2			
CO4	2	1	1	1		2							2	2	2			
CO5	2	1	1	1		2							2	2	2			

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2024-2025							
Course Code	B150104P/ES128	**Title of the Course**	Toxicant Analysis Lab	**L**	**T**	**P**	**C**
Year	1st	**Semester**	I	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 with Science	**Co-requisite**	NIL				
Course Objectives	1. Familiarize with the water analysis techniques to analyse acidity and alkalinity 2. Gain knowledge on BOD and COD. 3. Understand the basics of soil analysis						

Course Outcomes	
CO1	To know the basic idea on techniques of water analysis and acidity alkalinity.
CO2	To get experience with the calculations of BOD and COD.
CO3	To Understand the basics of air quality monitoring.
CO4	To have an experience on soil analysis

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Determination of physical parameters of water quality	Estimation of various physical water quality parameters like turbidity and conductivity	15	**CO1**
2	Determination of chemical parameter of water quality	Estimation of chemical water quality parameters like pH, Conductivity, alkalinity, DO etc.	15	**CO2**
3	Determination of air pollutants	$PM_{2.5}$ and PM_{10}	15	**CO3**
4	Determination of soil quality parameters	Measurement of soil parameters like pH, EC etc.	15	**CO4**

Reference Books:

AMRITA, OLABS, Study of pollutants in Air.

AMRITA, OLABS, Studies on Turbidity, pH and Microbial Presence in Water.

AMRITA, OLABS, Study of pollutants in Air.

e-Learning Source:

1. https://www.acs.org/greenchemistry/what-is-green-chemistry/examples.ht
2. https://www.ysi.com/parameters
3. PM - Particulate Matter, https://youtu.be/ZUsNCq8acYM.
4. Monitoring methods for Air – PM, https://youtu.be/-uZURNKE4z8.

	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	PSO6	PSO7
CO1	2	1	1	1		2							2	2	2	2		
CO2	2	1	1	1		2							2	2	2	2		
CO3	2	1	1	1		2							2	2	2	2		
CO4	2	1	1	1		2							2	2	2	2		
CO5																		

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session:2023-2024							
Course Code	**I150107T/ES131**	**Title of the Course**	Introduction to Natural Hazard and Disaster Management	**L**	**T**	**P**	**C**
Year	**1st**	**Semester**	I	**2**	**1**	**0**	**3**
Pre-Requisite	Basic science	**Co-requisite**	NIL				
Course Objectives	1. To impart basic knowledge of concept of Hazard, risk and vulnerability. 2. To understand types of hazards, their causes and impact. 3. Assessment of risk and vulnerability. 4. Acquiring knowledge about mitigation and preparedness to combat disaster. 5. To aware about role of government bodies in disaster management.						

Course Outcomes	
CO1	Gain basic knowledge of concept of Hazard, risk and vulnerability.
CO2	Acquired knowledge of hazards its impact.
CO3	Understand about Assessment of risk and vulnerability related to disaster.
CO4	Formulate, organize and assess disaster Risk reduction activities
CO5	Demonstrate and practice Disaster Management.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Concept of Disaster and Vulnerability**	Hazard and disaster -Concept; risk and vulnerability; Types of hazards-Natural hazards: hydrological, atmospheric & geological hazards, Causes of Earthquake, floods, cyclone, tsunami, landslides and drought.	10	CO1
2	**Impact of Disaster**	Global and National Perspective. Disaster profile of India, Case studies from Disasters, Large Hydro projects and its risks-Uttarakhand Dsisaster-2013.	10	CO2 CO3
3	**Disaster Management**	Component of Disaster Management-Preparedness and Mitigation, Phases of Disaster Management. Compensation and Insurance.	10	CO4 CO5
4	**Intervention of technologies**	Application of geoinformatics in hazard, risk & vulnerability assessment. Early warning System; PTWS & IMD.	10	CO5
5	**Disaster Risk Reduction**	Approaches to Disaster risk Reduction (DRR)- Role of public, education and media in DRR. Community Based DRR,International/National Humanitarian aid.	10	CO4
6	**Disaster Act. And Policies**	National Acts and policies for mitigating Disasters (Disaster Management Act 2005, National Policy for Disaster Management-2009, Institutional Framework for disaster management (NDMA, SDMA, SDMA &NIDM).	10	CO5

Reference Books:

1-Coppola D. P. 2007. Introduction to International Disaster Management. Butterworth Heinemann.

2-Cutter, S.L. 2012. Hazards Vulnerability and Environmental Justice. EarthScan, Routledge Press.

3-Keller, E. A. 2012. Introduction to Environmental Geology. Prentice Hall, Upper Saddle River, New Jersey.

4-Pine, J.C. 2009. Natural Hazards Analysis: Reducing the Impact of Disasters. CRC Press, Taylor and Francis Group.

5-Schneid, T.D. & Collins, L. 2001. Disaster Management and Preparedness. Lewis Publishers, New York, NY.

6-Smith, K. 2001. Environmental Hazards: Assessing Risk and Reducing Disaster. Routledge Press.

7-Wallace, J.M. & Hobbs, P.V. 1977. Atmospheric Science: An Introductory Survey. Academic Press, New York.

e-Learning Source:

https://www.researchgate.net/publication/323794760_Natural_Hazards_and_Disaster_Management

https://link.springer.com/article/10.1007/s11069-019-03677-2

https://ndmindia.mha.gov.in/images/public-awareness/Primer%20for%20Parliamentarians.pdf

SWAYAM MOOC, e-Skill India, Coursera, Udemy,NPTEL

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						2	2		-	-	-	-	3	2	2	1	1	-
CO2			2			2			-	-	-	-	2	2	3	1	1	-
CO3			2			2			-	-	-	-	1	3	2	1	1	-
CO4		3				2			-	-	-	-	1	3	1	3	3	-
CO5		2	2			2	2		-	-	-	-	1	1	3	3	3	-

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow Department of Environmental Science

Effective from Session: 2023-2024							
Course Code	I150108T/ES132	**Title of the Course**	Water Monitoring and Conservation Techniques	**L**	**T**	**P**	**C**
Year	**1st**	**Semester**	I	**2**	**1**	**0**	**3**
Pre-Requisite	10+2	**Co-requisite**	Basic knowledge of water				
Course Objectives	The objective of this course is to impart knowledge of hydrology that deals with the occurrence, distribution, movement, and properties of water on the earth. The students will also be aware of different water quality standards for the application of water in different sectors. It is expected to give an exposure to students of social and natural sciences and humanities for better understanding of water resources, water economics, water governance and policy.						

Course Outcomes

CO1	Describe the role water plays in the lithosphere, hydrosphere, cryosphere, atmosphere, and biosphere, with emphasis on interactions between these reservoirs.
CO2	Apply the scientific method to investigations of hydrologic processes, Earth systems, and interactions among the various physical and biological realms utilizing standard scientific field and laboratory methods.
CO3	Plan water quality surveillance for a given aquatic environment and to understand what a test result means in terms of the health of the ecosystem. water quality and water quality criteria and standards, and their relation to public health, environment, and urban water cycle
CO4	Use their knowledge environment, research skills to current issues pertaining to water resources, management, and remediation, with emphasis on related economic, social, and public policy dimensions.
CO5	Analyze, interpret, and report on laboratory and field findings using appropriate statistical techniques and computer applications.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to water**	Origin of water on earth, Unique properties of water (Polarity, Cohesion, Density, Surface Tension, Viscosity, Heat capacity, Boiling and freezing points, Temperature, Taste, Odour, Colour). Importance of water in human civilization (Mesopotamian and Indus), Water catastrophes: Historical perspective and consequences, Water infrastructure and tools (Ancient, Medieval and modern).	9	CO1 &2
2	**Hydrology and hydrological cycle**	Concept and scope of hydrology, Hydrological cycle: Evaporation: Process, Factors effecting evaporation, Measurement of evaporation, Transpiration: process, Factors affecting transpiration, Condensation: Process and measurement, Precipitation: Process, Types and forms, Measurement and distribution,	9	CO, 2& CO5
3	**Water conservation Practices**	Rainwater harvesting methods, classes, benefits, approach, water saving technologies, rainwater harvesting and drought mitigation, crop productivity and water security. Concept and definition of watershed, importance of watershed management and its role in conservation of natural resources. Methods of irrigation - surface, subsurface, sprinkler, drip and pitcher. Reducing water losses, water resource in India, water budget in India, planning and optimum use of water resources.	11	CO2, 3 &5
4	**Water resources and sustainable development**	Water as a resource, Dublin-Rio Principles on Water and Sustainable Development, Brief account of concept of water stress, scarcity, water footprint and virtual water trade, Right to Water (SDG-6); Entitlements and criteria, Concept and overview of Water, Sanitation and Hygiene (WASH), Swach Bharat Mission and National Water Mission,	9	CO 2,3,4 &5
5	**Water Resource: Governance and Policy**	Water Governance: Elements and dimensions of water governance; Effective water governance schemes; Indicators of good governance. Water Governance in India: Salient features of National water policy 2012 and Jammu and Kashmir Water Resource (Regulation and Management) act 2010, Conflicts in Water Pricing: Conflicts on subsidy verses sustainability, overview of global water conflicts and interstate water conflicts in India.	11	CO4 & CO5
6	**Water Economics**	Valuing of water: The use and non-use values of water, Introduction to water valuation methods: Non-revenue waters (NRW) and unaccounted for water (UFW); Metering water uses; Water management through economic instruments. Water Pricing - Approach and Models: Significance of water pricing Water pricing models - flat rate and uniform rate, Brief account of water pricing practices in India and abroad.	11	CO5

Reference Books:

Standard methods for the examination of water and wastewater published by APHA 15th ed.

Keith, L.H. [Ed.] 1988 Principles of Environmental Sampling. American Chemical Society

Mays, L.W. 2006. Water Resources Sustainability. The McGraw-Hill Publications.

Schward and Zhang, 2003. Fundamentals of Groundwater. John Willey and Sons.

Souvorov, A.V. 1999. Marine Ecologonomics: The Ecology and Economics of Marine Natural Resource Management. Elsevier Publications. Vickers, A. 2001.

Handbook of Water Use and Conservation. Water Plow Press.

Gleick, P. H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment &Security. Stockholm Env. Institute, Oxford Univ. Press.

e-Learning Source:

SWAYAM, MOOC, e-Skill India, Coursera, Udemy, National Digital Library of India

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1		2			2		3				3		2
CO2	3		2					2	3	2		2	
CO3	2				2			2					2
CO4			3			2		2			2	3	
CO5	3				3	2					3		3

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

Name & Sign of Program Coordinator	Sign & Seal of HoD

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2023-2024							
Course Code	B150301T /ES218	**Title of the Course**	Biodiversity and its Conservation	**L**	**T**	**P**	**C**
Year	2nd	**Semester**	III	**3**	**1**	**0**	**4**
Pre-Requisite	10+2	**Co-requisite**	NIL				
Course Objectives	1.To develop critical understanding of the theory and principles of biodiversity. 2.To predict pattern of biodiversity distribution. 3.Exploration of biodiversity and importance of biodiversity. 4.To identify various threats related to biodiversity. 5.To conserve all life forms through various methods						

Course Outcomes	
CO1	Gain knowledge on biodiversity its value and various approach for conservations.
CO2	Biodiversity of India and role of local communities and traditional knowledge in conservation.
CO3	Develop knowledge about biodiversity identification and distribution.
CO4	Understand the various conservation process.
CO5	Learn wildlife its importance, threat and management.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Biodiversity	Basic concepts; Types (Species diversity, Genetic diversity, Ecosystem diversity); Measurement of Biological Diversity; Biological and Phylogenetic Species Concept; Basic Concept of Species and Speciation.	8	CO1 CO2
2	Biodiversity Patterns	Gradient of Biodiversity, Spatial patterns: latitudinal and elevational trends in biodiversity. Temporal patterns: seasonal fluctuations in biodiversity patterns.	8	CO3
3	Biodiversity of India	India as a mega diversity nation; Biogeographic zones of country; Eco-sensitive zone; Concept and basis of identification of Biodiversity Hotspots	8	CO2 CO3
4	Importance of Biodiversity	Economic values–medicinal plants, drugs, fisheries and livelihoods. Social, aesthetic, consumptive, and ethical values of biodiversity. Ecological services.	8	CO1 CO5
5	Threats Identification	Factors for Decline of Biological Diversity, Concept of Extinction, Threatened and Endangered Species; IUCN categorization	6	CO5
6	Wildlife Management	General introduction; Definition, Importance; Reason for wildlife Depletion; Wildlife Management; Protection of Wild Flora, Fauna and Natural Habitats.	6	CO5
7	Conservation of biodiversity	Approaches for Conservation of Biological Diversity: In-situ conservation, Ex-situ conservation; Role of local communities and traditional knowledge in conservation; Biodiversity convention; International and national efforts to conserve biodiversity.	8	CO1 CO4
8	Protected Area Network	Concept of Biosphere Reserve; Structure and function of BR, National parks, Sanctuaries, and Sacred groves; important conservation projects	8	CO2 CO4

Reference Books:

1. Gaston, K J. & Spicer, J.I. 1998. Biodiversity: An Introduction. Blackwell Science, London, UK.
2. Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
3. Pandit, M.K. & Grumbine R.E. 2012. Ongoing and proposed hydropower development in the Himalaya and its impact on terrestrial biodiversity. Conservation Biology 26:1061-1071.
4. Primack, R.B. 2002. Essentials of Conservation Biology (3rd edition). Sinauer Associates, Sunderland, USA.
5. Singh, J. S. & Singh, S. P. 1987. Forest vegetation of the Himalaya. The Botanical Review 53: 80-192.
6. Singh, J. S., Singh, S.P. & Gupta, S. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications, NewDelhi.
7. Sodhi, N.S. & Ehrlich, P.R. (Eds). 2010. Conservation Biology for All. Oxford University Press.
8. Sodhi, N.S., Gibson, L. & Raven, P.H. 2013. Conservation Biology: Voices from the Tropics. Wiley-Blackwell, Oxford, UK

e-Learning Source:

1. https://ncert.nic.in/textbook/pdf/lebo115.pdf
2. https://www.cbd.int/
3. https://www.iucn.org/regions/europe/our-work/biodiversity-conservation
4. https://onlinecourses.nptel.ac.in/noc20_bt39/preview
5. https://onlinecourses.swayam2.ac.in/cec21_ge31/preview

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						3	1			1	
CO2				3			2						3	1			1	
CO3			1				2						3	1			1	
CO4						3	2						3	1			1	
CO5						3	2						3	1	2		1	

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2023-2024							
Course Code:	**B150302P/ES219**	**Title of the Course**	Practical on Understanding Biodiversity	**L**	**T**	**P**	**C**
Year	2nd	**Semester**	III	**0**	**0**	**4**	**2**
Pre-Requisite	10+2	**Co-requisite**	NIL				
Course Objectives	This course provides students the knowledge and understanding of lab related to Biodiversity						

Course Outcomes

CO1	Learn to prepare the field report and herbarium sheet.
CO2	Practical skills about analyses of primary productivity by light and dark bottle method.
CO3	Practical skill about the analyses of number of species in a given area and chlorophyll content of plant.
CO4	Gain knowledge on analysis and interpretation of different physical properties of soil.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Field Visit	Field study on ecology and biodiversity of flora and fauna of a local area/ex-situ conservation site and field report submission. Preparation of field report based on the survey of local flora (herbarium sheet).	15	CO1
2	Ecosystem Productivity	To determine the primary productivity by light and dark bottle method. Measure the rate of respiration in an aquatic environment using dissolve oxygen probe.	15	CO2
3	Study of Species	To find out the reproductive capacity of species. To determine the minimum size of quadrate by Species area curve method. To determine the density/ abundance of various species occurring in a given area. To study the species richness in a given area. To determine chlorophyll content of the given plant material.	15	CO3
4	Soil Analysis	To study pore space, water holding capacity and bulk density of soil. Qualitative analysis of soil organic carbon, Soil PH. To study the texture of soil depending upon the particle size.	15	CO4

Reference Books:

1. Anne E. Magurran, Brian J. McGill (2011) Biological Diversity: Frontiers in Measurement and Assessment. Oxford University Press. ISBN: 978-0199580675.
2. Loreau, M. & Inchausti, P. 2002. Biodiversity and Ecosystem functioning: Synthesis and Perspectives. Oxford University Press, Oxford, UK
3. Pandey, P.N. (2017). Biodiversity Environmental Science Forestry, Narendra Publication house.
4. Rao K.S, K.S. Rao (1993). Practical Ecology. Anmol Publication, 190 pages
5. Singh, J. S. & Singh, S. P. 1987. Forest vegetation of the Himalaya. The Botanical Review 53:80-192.
6. Dane, J.H. & Topp, G.C. (2004). (eds) Methods of Soil Analysis: Part 4, Physical Methods. SSSA
7. Kaushik, Anubha and Kaushik, C.P. (2018) Perspectives in Environmental Studies.

e-Learning Source:

1. Study of soil pH, https://youtu.be/ViWCoeFwH9M.
2. Preparation of herbarium sheets, https://youtu.be/CK4vepuWzrM
3. Herbarium - CSIR-NBRI, https://youtu.be/6tJdvDzPzR8.
4. Primary productivity, https://youtu.be/9LpMskfUgz0.
5. Light-Dark bottle method, https://youtu.be/i5Tit4BgfIE.
6. AMRITA, OLABS, Study of Physical Properties of Soil. http://amrita.olabs.edu.in/?sub=79&brch=18&sim=235&cnt=1

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

PO-PSO CO	PO1	PO 2	PO 3	PO 4	PO5	PO6	PO 7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	-	1	-	1	2	2						2	2	2	2	2
CO2	1	1	-	-	1	2	2						2	2	2	2	2
CO3	2	1	-	-	-	1	2						2	1	2	2	2
CO4	2	-	-	-	-	2	2						2	1	1	2	2

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2023-24							
Course Code	**B150303T/ES220**	**Title of the Course**	Human-Wildlife Conflict & Management	**L**	**T**	**P**	**C**
Year	2nd	**Semester**	III	**3**	**1**	**0**	**4**
Pre-Requisite	10+2	**Co-requisite**	Nil				
Course Objectives	Provide general introduction about wildlife management, To study Role of government in wildlife conservation and management. The evolution of wildlife conservation and policies regarding protected areas in 21th century. To study different typesof Environmental Act. for wildlife conservation. Importance of forest produce to tribal population and tribal right in India. Impact of human wildlife conflict in environment.						

Course Outcomes	
CO1	To Provided knowledge of government in Biodiversity conservation.
CO2	Be able to explain protected areas and Evolution of wildlife conservation.
CO3	To create knowledge Environmental Act. for wildlife conservation.
CO4	To provided knowledge tribal population and tribal right in India.
CO5	To provided knowledge of human wildlife conflict.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to wildlife management	Need of Wildlife management; Reasons of Man-wildlife conflict, Importance of Wild life conservation, Role of government, biologists and social scientists in Wildlife management.	06	CO1
2	Protected area and types	Protected area: Types of protected areas, Wildlife Sanctuaries, National Parks, Biosphere Reserves. IUCN categories. Concept of deep and Shallow ecology.	06	CO1
3	Evolution ofwildlife management	Journey of mankind from predator to conservator. Prehistoric association between wildlife and humans: records from Bhimbetkawall paintings. Conservation of wildlife in the reign of king Ashoka: excerpts from rock edicts, Bishnoi community. Understanding wildlife management, conservation and policies regarding protected areas in 21st century.	08	CO2
4	Wildlife conservationpolicies in India	National policy governing wildlife protection in India, Historical perspective evolution of policies during different eras. Current policy, National Wildlife action plan and its detailed review. Concept of core and buffer area in a protected range.	08	CO3
5	Wildlife conservation Acts in India	Brief introduction to Wildlife Protection Act of 1972, Forest Act 1927, Environmental Protection Act 1986, and Forest conservation Act 1980. Introduction of Tiger task force and National Tiger Conservation Authority.	08	CO3
6	Legal basis of wildlife conflicts	Impact of conflict on humans and wildlife, impact of habitat fragmentation, social inequality in terms of forest conservation. The nature and extent of legal and illegal trade in wildlife species. Illegal wildlife trade in India and different parts of the world. Major trade routes and trade centers with reference to India.	08	CO4
7	Introduction to tribal rights	Introduction to tribal rights in India. Importance of forest produce to tribal populations. Scheduled tribes and other traditional Forest dwellers (Recognition of forest right) Act, 2006.	08	CO4
8	Wildlife Conflicts	Insight into the important conflicts: Keoladeo National Park conflict of Bharatpur, Human and Elephant conflicts of Kerala and West Bengal, Fisherman and tiger conflict of Sundarbans Forest, Shifting cultivation in North east India.	08	CO5

Reference Books:

1-Conover, M. 2001. Resolving Human Wildlife Conflicts, CRC Press.

2-Dickman, A. J.2010.Complexities of conflict: the importance of considering social factors for effectively resolving human–wildlife conflict. Animal Conservation **13:** 458-466.

3-Messmer, T. A. 2000. The emergence of human–wildlife conflict management: Turning challenges into opportunities. International Bio deterioration & Biodegradation**45**:97-102.

4-Paty, C. 2007. Forest Government and Tribe. Concept Publishing Company.

5-Treves, A. & Karanth, K. U. 2003. Human---carnivore conflict and perspectives on carnivore management worldwide. Conservation Biology**17**: 1491- 1499

6-Woodroffe, R. 2005. People and Wildlife: Conflict and Coexistence. Cambridge.

Woodroffe, R., Thirgood, S., & Rabinowitz, A. 2005. People and Wildlife, Conflict or Coexistence? (No. 9). Cambridge University Press

e-Learning Source:

https://www.slideshare.net/sajjadmughal3344/human-wildlife-conflict-75556196
https://www.slideshare.net/kpkc1633/human-wildlife-conflict-in-banke-national-parknepal
https://www.slideshare.net/SAISIKANPATRA/human-wildlife-conflict-155300729
https://slideplayer.com/slide/4897971/
https://www.slideshare.net/subinkmohan/strategies-adopted-to-mitigate-humanelephant-conflict-hec-in-and-around-kerala-
https://www.slideshare.net/rajatrmr/wildlife-presentation-87241681forest

Course Articulatio Matrix: (Mapping f CO ith PO nd PSOs)

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

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2023-2024							
Course Code	**B150304P/ ES221**	**Title of the Course**	Wildlife Management Lab	**L**	**T**	**P**	**C**
Year	**2nd**	**Semester**	III	**0**	**0**	**4**	**2**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	This course provides the concepts, essential elements and skills related to wildlife conservation and management. Additionally, the concept of agroforestry and its establishment. Furthermore, ecosystem studies explore the differences, in between interlink and its structure, functioning aspects.						

Course Outcomes	
CO1	Student will explore the Sanctuaries / National Park and understand about wildlife.
CO2	Case study of threats to wetlands
CO3	The student will be to understand the principle and component of Agroforestry.
CO4	Student will learn about abiotic and biotic component of terrestrial ecosystem.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Wild life field Visit	Visit to Wild life Sanctuary/National Park.	15	CO1
2	Visit to wetlands	Visit and documentation of threats to wetlands	15	CO2
3	Agroforestry concept/system	To study about the component of Agroforestry system.	15	CO3
4	Ecosystem Studies	To study Forest ecosystem.	15	CO4

Reference Books:

1. B. B. Hosetti, M. Venkateshwarlu Wildlife Management and Conservation: Contemporary Principles and Practice
2. S K Gupta Textbook of Wildlife Management 3rd Edition 2020
3. Rangarajan M. (2001) India's Wildlife History, Permanent Black, New Delhi, India.

e-Learning Source:

1. https://drive.google.com/file/d/1izgQNDS-djRymkXZ9DLvP7N4wQGWoP1i/view

2. https://www.cifor-icraf.org/publications/pdf/books/Agroforestry-primer-02.pdf

3. https://www.rlbcau.ac.in/pdf/Forestry/FWM-136%20%20Wildlife%20biology.pdf

	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**	**1**	**1**	**1**	**2**	**3**	**1**	_	-	_	_	_	**1**	**2**	**3**	**3**	**3**	_
CO2	**3**	**1**	**1**	**1**	**2**	**3**	**1**	_	-	_	_	_	**1**	**2**	**3**	**3**	**3**	_
CO3	**3**	**1**	**1**	**1**	**2**	**3**	**1**	_	-	_	_	_	**1**	**2**	**3**	**3**	**3**	_
CO4	**2**	**1**	**1**	**1**	**2**	**3**	**1**	_	-	_	_	_	**1**	**2**	**3**	**3**	**3**	_

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2023-2024							
Course Code	**B150305T/ ES222**	**Title of the Course**	Fundamentals of Remote Sensing, Geographic Information System	**L**	**T**	**P**	**C**
Year	**2nd**	**Semester**	**III**	**3**	**1**	**0**	**4**
Pre-Requisite	10+2	**Co-requisite**	NIL				
Course Objectives	• To study remote sensing, GIS techniques and its component and different types of platforms. • Measurement of EMR interaction with environment by satellite, sensors and aerial photography. • Geographical analysis by Raster and Vector data set. • Statistical analysis of geographical data structure. • To monitoring natural resource, forest diversity and urban sprawl analysis by Remote Sensing and GIS Technology.						

Course Outcomes	
CO1	To develop basic knowledge of remote sensing and GIS.
CO2	To provide knowledge of monitoring biodiversity by satellite, sensors and aerial photography.
CO3	To provide knowledge of Geographical analysis by Raster and vector data.
CO4	To create knowledge of Statistically analysis of geographical data structure.
CO5	Be able to describe applications of Remote Sensing and GIS Technology.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to RemoteSensing and GIS	Remote Sensing and GIS: Definition and Components, Development, Platforms and types.	8	**CO**1
2	Photogrammetry	Aerial Photography and Satellite Remote Sensing: Principles, Types and Geometry of Aerial Photograph; Principles of Remote Sensing, EMR Interaction with Atmosphere and Earth Surface; Satellites (Landsatand IRS) and Sensors.	8	**CO**2
3	Digital Cartography	Topographic sheets and its numbering system, Datum, Map Scale, Time, Latitude, Longitude, Map projections etc.	6	**CO**3
4	Digital Image Processing (DIP)	Image Processing (Digital and Manual) and Data Analysis: Pre-processing (Radiometric and Geometric Correction), Enhancement (Filtering); Classification (Supervised and Un-supervised), Geo-Referencing;Editing and Output; Overlays.	8	**CO**3
5	Geographical Information System (GIS)	GIS Data Structures: Types (spatial and Non-spatial), Raster and Vector Data Structure. Overview of GIS software packages; GPS survey, data import, processing, and mapping.	6	**CO**4
6	Basic elements of statistical analyses	Mean, Median, Mode; Standard Deviation (SD); Types of sampling distribution – normal, binomial, Poisson; measurements of central tendency and dispersion	8	CO4
7	Application of RemoteSensing and GIS	Land use/ Land Cover, Urban SprawlAnalysis; Soil, Water resource management, Forest resources, Agriculture, Disaster Relief Management	8	**CO**5
8	Case studies	Case studies of Remote Sensing and GIS, Free open data sources: USGS, BHUVAN, WRIS, NOAA	8	**CO**5

Reference Books:

1) Campbell J. B., 2007: Introduction to Remote Sensing, Guildford Press.
2) Lillesand T. M., Kiefer R. W. and Chipman J. W., 2004: Remote Sensing and Image Interpretation, Wiley. (Wiley Student Edition).
3) Joseph, G. 2005: Fundamentals of Remote Sensing, United Press India.
4) Wolf P. R. and Dewitt B. A., 2000: Elements of Photogrammetry: With Applications in GIS, McGraw-Hill.
5) Chauniyal, D.D. (2010) Sudur Samvedan evam Bhogolik Suchana Pranali, Sharda Pustak Bhawan, Allahabad
6) Chang.T.K. (2002). Geographical Information System.Tata MacGraw-Hill.

e-Learning Source:

https://www.nrsc.gov.in
https://www.iirsisro.gov.in
https://www.youtube.com/watch?v=3fbEVytyJCk

	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	3	3	3	3	2	-	-		-	-	2	2	2	2	2	-
CO2	3	3	3	3	3	3	3	-	-	-	-	-	3	2	2	2	2	-
CO3	3	3	2	2	3	2	3	-	-	-	-	-	3	2	2	2	2	-
CO4	3	2	2	3	2	2	3	-	-	-	-	-	3	2	2	2	2	-
CO5	3	3	3	3	3	3	3	-	-	-	-	-	3	3	3	3	3	-

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2023-2024							
Course Code	**B150306P/ES223**	**Title of the Course**	Geographical Information System Lab	**L**	**T**	**P**	**C**
Year	**2nd**	**Semester**	III	**0**	**0**	**4**	**2**
Pre-Requisite	10+2	**Co-requisite**	Nil				
Course Objectives	This course provides the basic step, types and elements of image interpretation. Student will also learn the GIS software, demonstration of the GPS and Free open data source link.						

Course Outcomes

CO1	To understand the topographic map numbering system, how to download datasets.
CO2	Student will be able to prepare maps using digital software Arc GIS.
CO3	Student will explore the GPS navigation device.
CO4	Student will explore the free access website for satellites imagery

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	GIS Tool	Study of SOI topographic sheet, Georeferencing	15	CO1
2	Data Analysis	Vector and Raster Image analysis	15	CO2
3	Navigation System	Handling of GPS, data collection and integration of GPS data	15	CO3
4	Open-source web link	Earth resource satellites; Landsat, SRTM, CARTOSAT, TRMM, MODIS, NOAA	15	CO4

Reference Books:

1. Fundamentals of Geographic Information Systems, Michael N. Demers: John Wiley and Sons, Inc
2. Lillesand, T.M., and Kieffer, R.M., 1987: Remote Sensing and Image Interpretation, John Wiley.
3. Chang.T.K. 2002: Geographic Information Systems. Tata McGrawHill
4. Skidmore A.2002: Environmental Modeling with GIS and Remote Sensing. Taylor and Francis.

e-Learning Source:

1. http://www.nrsc.gov.in

2. https://youtu.be/-2B6kjtdfuE

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

PO-PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	**2**	**2**	**2**	**1**	**1**	**3**	**3**	_	-	_	_	_	**3**	**2**	**3**	**1**	**3**	_
CO2	**3**	**3**	**2**	**1**	**1**	**3**	**3**	_	-	_	_	_	**3**	**3**	**3**	**1**	3	_
CO3	**3**	**3**	**3**	**1**	**1**	**2**	**2**	_	-	_	_	_	**2**	**3**	**3**	**2**	**3**	_
CO4	**2**	**2**	**1**	**1**	**1**	**3**	**3**	_	-	_	_	_	**3**	**3**	**3**	**3**	**3**	_

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2022-23							
Course Code	I150307T/ ES224	**Title of the Course**	Environment and Economics	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	2	0	1	3
Pre-Requisite	10+2	**Co-requisite**	Nil				
Course Objectives	The purpose of this course is to impart basic and key knowledge of Environmental Impact and Risk Assessment. This will help in enhancing knowledge of Environmental Impact assessment Process, methodologies of Environmental Impact assessment and Risk assessment. After successfully completion of course, the student will be able to explore subject into their respective dimensions.						

Course Outcomes	
CO1	Students will be able to analyse the role of ecological economics in influencing the demand and Supply in Markets and environmental policy.
CO2	Students will be able to evaluate costs and benefits of pollution control by adopting market-based instruments for controlling Environmental pollution.
CO3	Create an understanding among Students about how guiding principles of sustainable developmental help in facing global challenges of sustainable development.
CO4	Students will be able to analyse importance of strategies of global sustainability in developing instruments for implementing Sustainability.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Ecological Economics	Scope and Importance of Ecological Economics, Economics and Environmental Policy, market mechanisms and choices, benefits of Environmental protection: Demand and supply, market Price and Quality: Environmental Externalities and the problem of social cost. Valuation of Ecosystem services, Value Addition in Agriculture Crops, Agricultural Marketing.	10	CO1
2	Ecological Cost Benefits	Economic Analysis of Climate change, Benefits of controlling Green House Gasses, Cost of Controlling Green House Gasses, Carbon Trading and CDM mechanisms. Measuring the Cost and Benefits of Pollution control, Overview of Cost Benefit Analysis, Economic Principles of Cost Benefit Analysis.	10	CO2
3	Environmental Protection	Measurement of Economic Value of Environment, contingent valuation method, Travel Cost Methods, Hedonic Market Methods, Market Based Instruments for Pollution Control, Systems of Integrated Environmental accounting, Green Accounting.	10	CO2
4	Economic Sustainability	Definition and Dimensions of Sustainability, Global Challenges of Sustainable Development, The Ecological Footprint, Global Environmental Monitoring and Assessment, Guiding Principles of Sustainable Development, National Sustainable Development Strategies, Sustainability Indicators, Models of Sustainability, Environmental Sustainability Index, Global Action and Sustainable Development, Education for Sustainability.	10	CO3
5	Strategies of Global Sustainability	An Economic perspective to Sustainability, Strategies for Global Sustainability, Instruments for implementing Sustainability-Finding Right Prices, the Hardwick - Sorrow rule, Critical Rental Capital, Safe minimum Standard, Steady State Principles. Policy Implications for implementing Sustainability.	10	CO4
6	Economic Solutions to Environmental Programs	Social Cost and Benefits of Environmental Programs, Marginal Social benefit of Abatement, Marginal Social Cost of Abatement, pollution control, Policies for Controlling Air and Water Pollution, Disposal of Toxic and Hazardous Waste –Standards vz. emission charges, environmental subsidies, modelling and emission charges, polluter pays principle, pollution permit Trading system.	10	CO2

Reference Books:

1- Bhattacharya, R.N. 2001.An Economic perspective, Oxford University Press.

2.-Environmental Economics and Sustainability, Jose G Varghas- Hernandes, Monowar Alam Khalid. Pawan Kumar Bharti, 2018. Discovery Publishing House Pvt. Ltd ISBN 978-93-86841-37-7 Pg 202.

3-Hanley, Nick and Roberts C.J.2002, Issues in Environmental Economics, Black well Publishers, U. K

4-Ward F. A. 2006, Environmental and Natural Resource Economics, Pearson Prentice Hall, New Jersey.

e-Learning Source:

1-https://www.soas.ac.uk/cedep-demos/000_P570_IEEP_K3736-Demo/module/pdfs/p570_unit_01.pdf

2-https://www.sfu.ca/~wainwrig/Econ400/documents/Econ_460_Lecture-Notes-part_One-10-3.pdf

3- https://ocw.mit.edu/courses/economics/14-42-environmental-policy-and-economics-spring-2011/lecture-notes/

4- https://nptel.ac.in/courses/109107171/

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

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session:							
Course Code	I150308T/ES226	**Title of the Course**	Environment and Sustainability	**L**	**T**	**P**	**C**
Year	2nd	**Semester**	III	**2**	**1**	**0**	**3**
Pre-Requisite	10+2	**Co-requisite**	Basic knowledge of environment				
Course Objectives	A sustainable human society is one that satisfies its needs without jeopardizing the opportunity of future generations to satisfy theirs. The challenge of how we achieve a sustainable society is a vital theme that unites the various disciplines within environmental studies. This course is designed to help the students to bridge the scientific approach to analyzing and solving environmental problems with the socioeconomic concerns involved in formulating and administering environmental policy and the historic and philosophical basis of humanity's relationship to ecosystems. With the common goal of defining and understanding environmental sustainability, the course identifies how each participating discipline can creatively contribute towards this end.						

Course Outcomes

CO1	Understand the basic concept of Sustainable Development (SD), the environmental, social and economic dimensions.
CO2	In depth learning and analysis of factors that support to achieve sustainability and resilience in an individual level and in a community
CO3	Develop an encompassing understanding of sustainability issues.
CO4	Understand the embedment of sustainability issues in environmental, societal, and economic systems, and the relevance of the conditions, interrelations, and dynamics of these systems.
CO5	Demonstrate knowledge and understanding of the current sustainable development policies followed by selected countries

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to Sustainable Development**	Broad introduction to SD - its importance, need, impact and implications; definition coined; evolution of SD perspectives (MDGs AND SDGs) over the years; recent debates; 1987 Brundtland Commission and outcome; later UN summits (Rio summit, etc.) and outcome.	8	CO1 &2
2	**Dimensions to Sustainable Development**	Society, environment, culture and economy; current challenges - natural, political, socio-economic imbalance; sustainable development initiatives and policies of various countries: global, regional, national, local; needs of present and future generation - political, economic, environmental.	8	CO, 2& CO5
3	**Gauging Sustainable Development**	Sustainability and development indicators and SDGs, UN's outlook of sustainable development and efforts, UN SDGs - structure, governance and partnerships; communities / society: ensuring resilience and primary needs in society; biosphere: development within planetary boundaries; strengthening institutions for sustainability; shaping a sustainable economy.	10	CO2, 3 &5
4	**Challenges for SD**	Climate change, resource depletion, food-energy-water nexus, eutrophication, acidification, human/ecosystem toxicity, smog, ozone depletion. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.	10	CO 2,3,4 &5
5	**Sustainability Practices**	Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles, carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socioeconomical and technological change.	12	CO4 & CO5
6	**Activities**	Plantation, best out of waste, Determine Your Carbon Footprint, Visit the Local Recycling Centre, Composting, Plastic Pollution strategy, Save Energy, Inspire Sustainable Attitudes	12	CO1, 2,3,4 &5

Reference Books:

Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.

Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.

Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.

Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.

Environment Impact Assessment Guidelines, Notification of Government of India, 2006.

Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

e-Learning Source:

SWAYAM, MOOC, e-Skill India, Coursera, Udemy, National Digital Library of India

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1		2			2		3				3		2
CO2	3		2					2	3	2		2	
CO3	2				2			2					2
CO4			3			2		2			2	3	
CO5	3				3	2					3		3

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2023-2024							
Course Code	B150401T/ES227	**Title of the Course**	Environmental Pollution & Management	**L**	**T**	**P**	**C**
Year	2nd	**Semester**	IV	**3**	**1**	**0**	**4**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	1. It will enable students to understand environmental problems, looking at causal linkages between pollution sources, exposure pathways and impacts to environmental quality and human health. 2. Students will identify the complex relationships between environmental factors and human health, taking into account multiple pathways and interactions, will be assessed in a broader spatial, socioeconomic and cultural context. 3. Students will learn how to assess pollution sources, study exposure pathways and fate, and evaluate consequences of human exposure to pollution and its impacts to environmental quality. 4.Providing the evidence base to support decision and policy making, students should be able to understand pollution problems, consider ways to respond to them, and propose appropriate solutions/actions to reduce (protect, mitigate or prevent) pollution risks when necessary						

Course Outcomes	
CO1	Have gained awareness of current forms of environmental pollution and an overview of both their causes and consequences to natural, economic and social systems.
CO2	Students understands the fundamental principles governing the interactions between those systems (i.e. transport of pollutants in the environment)
CO3	Have been exposed to learning examples of good practice of technologies and options used to remediate reduce/eliminate pollution of the environment.
CO4	Be able to analyse, synthesize, and evaluate evidence to understand problems and accordingly select control measures and techniques concerning atmospheric, water or terrestrial challenges.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Environmental Pollution	Environmental pollution, types of environmental pollutants, basis and challenges of environmental pollution	**6**	**CO1**
2	Air pollution	Air Pollution- natural and anthropogenic sources, Types of air pollutants, effects of air pollutants- acid rain, greenhouse effect and global warming, air pollution control measures.	**8**	**CO1**
3	Water Pollution	Sources of surface and ground water pollution, water quality parameters and standards, effect of water contaminants on human health, Water remediation techniques.	**8**	**CO2**
4	Water Treatment Methods and Strategies	Water treatment: Wastewater treatment technologies- Primary, secondary and tertiary treatments	**8**	**CO3**
5	Soil Pollution	Soil pollution: Sources- Industrial, Domestic, Agricultural (Pesticides, heavy metals, industrial effluents, waste disposal), Effects of soil pollutants on plants, animals and ground water.	**8**	**CO4**
6	Thermal pollution	Thermal pollution: causes, effects and control measures	**6**	**CO4**
7	Noise Pollution	Noise Pollution: Sources, sound pressure levels, decibels, intensity and duration, effects of noise pollution on human and animals, noise permissible standards, noise control measures.	**8**	**CO5**
8	Radioactive pollution	Radioactive pollution: Sources, radioactive elements, effects of radiation on surrounding environment, Radioactive waste disposal methods	**8**	**CO5**

Reference Books:

1.Khopkar SM (1993) Environmental Pollution Analysis

2.Saxena HM (2011) Environmental Geography

3. Rao CS (1993) Environmental Pollution Control

e-Learning Source:

1-https://www.frontiersin.org/articles/10.3389/fpubh.2020.00014/full

2-https://www.hindawi.com/journals/jeph/2012/341637/

3-https://www.epa.gov/air-quality-management-process/managing-air-quality-human-health-environmental-and-economic

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

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

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Department of Environmental Science

Effective from Session: 2023-2024							
Course Code	**B150402P/ES228**	**Title of the Course**	Practical on Environmental Pollution	**L**	**T**	**P**	**C**
Year	2nd	**Semester**	IV	**0**	**0**	**4**	**2**
Pre-Requisite	10+2	**Co-requisite**	NIL				
Course Objectives	This course provides students with a working knowledge of the determination of water parameters, air pollutants, amount of dust (particulate matter) deposition on the leaves of roadside plants, segregating domestic waste into bio-degradable and non-biodegradable components and can Determine the Noise levels of residential, institutional and industrial area.						

Course Outcomes	
CO1	Practical knowledge for the determination of different water parameters.
CO2	Practical knowledge for the analyses of different air pollutants.
CO3	Gain knowledge on segregation and components of waste.
CO4	Learn the measurement of noise levels in different areas.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Determination of Water parameter	(i) DO (ii) BOD (iii) Alkalinity (iv) TDS (v) Turbidity	15	CO1
2	Determination of Air pollutants And Measurement of deposition of particulate matter on plants	RSPM, SPM , To estimate the amount of dust (particulate matter) deposition on the leaves of roadside plants.	15	CO2
3	Segregation of waste	To segregate domestic waste into bio-degradable and non-biodegradable components.	15	CO3
4	Determination the Noise levels	Determination the Noise levels of residential, institutional and industrial area.	15	CO4

Reference Books:

AMRITA, OLABS, Study of pollutants in Air.

AMRITA, OLABS, Studies on Turbidity, pH and Microbial Presence in Water.

e-Learning Source:

http://amrita.olabs.edu.in/?sub=79&brch=18&sim=240&cnt=1.

http://amrita.olabs.edu.in/?sub=79&brch=18&sim=229&cnt=1.

PM - Particulate Matter, https://youtu.be/ZUsNCq8acYM.

Monitoring methods for Air – PM, https://youtu.be/-uZURNKE4z8.

Noise pollution measurement by sound level meter, https://youtu.be/j4sq4CmGV5o.

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO6	PSO7
CO1	2	1	1	1							2	2	2	2		
CO2	2	1	1	1							2	2	2	2		
CO3	2	1	1	1							2	2	2	2		
CO4	2	1	1	1							2	2	2	2		
CO5																

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Department of Environmental Science

Effective from Session: 2023-2024							
Course Code	**B150403T/ES229**	**Title of the Course**	Basics of Environmental Methods and Analytical Techniques	**L**	**T**	**P**	**C**

Year	II	Semester	IV	3	1	0	4
Pre-Requisite	10+2	Co-requisite					
Course Objectives	This subject enables the students to learn the different parameters of Environmental methods for analysis						

Course Outcomes

CO1	Student gain an insight about different aspects of analytical environmental methods and soil analysis
CO2	Demonstrate extensive knowledge of the ecological instrumentation and spectrophotometry
CO3	Students can describe the most common methods of electrophoresis and instrumental analysis
CO4	Students will be able to explain the general parameters of water analysis
CO5	Students will be able to explain different air sampling equipments

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	Soil collection and preservation, Significance, Importance of Water, soil and air analysis	8	CO1
2	Soil Analysis	Analysis of particle size, water holding capacity, temperature, pH, conductivity, exchangeable calcium and Magnesium, sodium and potassium, available phosphorus, nitrogen, alkalinity, chlorides, sulphates, organic matter	8	CO1
3	Ecological Instrumentation	Humidity measurement, rainfall measurement, pH meter, calorimeter, Principles of chromatography	6	CO2
4	Spectrophotometry	Spectrophotometer, Principle, Spectroscopy, UV-visible spectrophotometer, Atomic absorption spectrophotometer	8	CO2
5	Electrophoresis	Electrophoresis, Paper Electrophoresis, Gel Electrophoresis, Application of Electrophoresis	6	CO3
6	Instrumental Analysis	High-performance liquid chromatography (HPLC), Thin layer chromatography Gas chromatography, Application of HPLC	8	CO3
7	Water Analysis	Chemical water quality parameters: chloride, Ammonium, Nitrite, Nitrate, Phosphate, Hardness, Water testing methods	8	CO4
8	Air Analysis	Emission sources: Particulates, Lead, Ash, Nanoparticles, Gaseous Pollutants, Types of Air Sampling Equipments.	8	CO5

Reference Books:

1-Chapin, F.S., Matson, P.A. and Mooney, H.A. 2002. Principles of Terrestrial Ecosystem Ecology. Springer-Verlag, New York.

2-Clark, R.N. 1999. Spectroscopy of Rocks and Minerals, and Principles of Spectroscopy.

3-U.S. Geological Survey, Denver

4-John Wainwright and Mark Mulligan (Eds).2004. Environmental Modelling: Finding Simplicity in Complexity. John Wiley & Sons Inc., New York.

5-Manahan, S.E. 2000. Environmental Chemistry. Seventh Edition. Lewis Publishers, NY

6-Odum, E.P. (1971), Fundamentals of Ecology: Saunders, Philadelphia.

e-Learning Source:

https://www.slideshare.net/joy_jnu/environment-analy

https://slideplayer.com/slide/274533/

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

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	2	2									1	2				
CO2	2	2									2	1				
CO3	1	2									2	2				
CO4	2	1									2	2				
CO5	1	1									2	2				

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

Name & Sign of Program Coordinator	Sign & Seal of HoD

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2022-23							
Course Code	B150404P//ES230	Title of the Course	Analytical Techniques Labs	L	T	P	C

Year	2nd	**Semester**	IV	**0**	**0**	**4**	**2**
Pre-Requisite	10+2	**Co-requisite**	NIL				
Course Objectives	To know the basic guidelines and working of Composting. To develop student interest in the field of survey of eco-system and technical skills in the field of environment.To help students to acquire the experimental knowledge of nutrients present in the soil.						

Course Outcomes

CO1	Develop the practical knowledge about the composting.
CO2	Develop the practical knowledge to determine the working of Atomic Absorption spectrophotometer.
CO3	Gain knowledge about the general prone areas of environment and understand the working of water treatment plant.
CO4	To understand the handling of air pollution control equipment and sound level meter.
CO5	Develop the knowledge of nutrients present in the soil.

UnitNo.	Title of the Unit	Content of Unit	ContactHrs.	Mapped CO
1	Working of composting and detection of heavy metals	Demonstration of Composting techniques. Demonstration of working of an Atomic Absorption spectrophotometer for detecting heavy metals.	15	1,2
2	Study of prone areas	Preparation of hazard zone map of India for landslides and Earthquakes, floods etc.	15	3
3	To study working of water treatment plants and survey of pollution control equipments	Visit to Waste water treatment plant. Visit to industry for survey of air pollution control equipments.	15	3,4
4	Study of noise level and nutrients in soil	Measurements of noise level using sound level meter. To study the NPK of soil samples by using soil testing kit.	15	4,5

Reference Books:

Rao M. N and H.V.N. Rao,1989: Air pollution, Tata McGraw Hill Publishing Co. Ltd., New Delhi

Misra, R,1986. Ecology workbook Oxford and IBH Publishing Co., New Delhi.

Khopkar S.M.,1993; Environment Pollution Analysis, Eastern Limited, New York

e-Learning Source:

https://www.youtube.com/watch?v=mDIVpJgjoXQ&ab_channel=UrbanGardening

https://www.youtube.com/watch?v=5fvWhCk7x6U&ab_channel=Edmerls

https://www.youtube.com/watch?v=-a5NT4-6qSE&ab_channel=krishivalley

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	PSO7
CO1	3	3	2	2									2	**3**	**3**	**3**		
CO2	3	1	2	1									3	**2**	**3**	**2**		
CO3	3	2	3	1									2	3	2	3		
CO4	3	2	2	1									2	**2**	2	**2**		
CO5	3	2	2	2									**2**	3	2	3		

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2022-23

Course Code	B150405T /ES231	Title of the Course	Soil Conservation and its Management	L	T	P	C
Year	2nd	Semester	IV	3	1	0	4
Pre-Requisite	10+2	Co-requisite	NIL				
Course Objectives	To develop the scientific attitude among the students for land and soil conservation. To develop attitude towards the fundamental education of soil among the students. To develop clear thinking about land use pattern awareness among the students. To develop attitude towards soil pollution, its degradation among the students. To provide knowledge to students about rational and scientific thinking about the measures to abate soil degradation.						

Course Outcomes

CO1	Students can enhance their knowledge about soil erosion and conservation.
CO2	Students can increase their knowledge about soil and its related parameter in sustained manner without deteriorating soil health.
CO3	Students can get efficient prospect to know about soil health and nature with development of new agricultural practices and technology.
CO4	Restoration of ecological balance by harnessing, conserving and developing natural resources.
CO5	To minimize soil erosion in the biodiversity rich areas and farm lands by implementing advance sustainable and government green practices.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	Land as a resource, soil health, types and causes of soil degradation; impact of soil degradation on agriculture and food security; need for soil conservation and restoration of soil fertility.	6	CO1
2	Fundamentals of soil science	Soil formation, classification of soil, physical properties of soil, soil texture, soil water holding capacity, soil temperature; soil colloids, soil acidity and alkalinity. soil organic matter, nutrients in soil: nitrogen, sulphur, potassium and phosphorus, soil biodiversity.	**8**	CO2
3	Soil degradation	Soil resistance and resilience, nature and types of soil erosion, losses of soil moisture and its regulation, nutrient depletion in soil, soil degradation due to mining and mineral extraction, toxic organic chemicals and organic contaminants in soils.	**8**	CO3
4	Land use pattern changes	Land resources: types and evaluation; biological and physical phenomena in land degradation; visual indicators of land degradation; drivers of land degradation-deforestation, desertification; habitat loss, loss of biodiversity, range land degradation, land salinization.	**8**	CO4
5	Human Activities	Human population pressure, poverty, socio-economic and institutional factors. Drivers of land use and land cover change in major geographic zones and biodiverse regions with particular reference to the Himalaya and the Western Ghats	**8**	CO4
6	Soil Conservation Practices	Crop Rotation, Contour ploughing, Cover cropping and Mulching, Conservation Tillage, Afforestation, Fertilizers and its management, Improving agricultural practices.	**6**	CO2
7	Sustainable Practices	Sustainable land use planning, role of databases and data analysis in land use planning control and management, land policy, Institutional and sociological factors, participatory land degradation assessment, integrating land degradation assessment into conservation.	**8**	CO5
8	Advanced methods for soil conservation	Organic farming, Grassed waterways**,** Chemical free farming, Integrated pest management, Government schemes- Rashtriya Krishi Vigyan Yojana, Cherrapunjee Ecological Project-Restoration of Degraded Lands under Sohra Plateau.	**8**	CO5

Reference Books:

1.Brady, N.C. & Well, R.R. 2007.The Nature and Properties of Soils (13th edition), Pearson Education Inc.

2.Gadgil, M. 1993. Biodiversity and India' s degraded lands. Ambio 22: 167-172.

3.Johnson, D.L. 2006. Land Degradation (2nd edition). Rowman & amp; Littlefield Publishers.

e-Learning Source:

https://www.youtube.com/watch?v=RWw09HU5n2I

https://www.youtube.com/watch?v=b3V988XYD-I

https://www.youtube.com/watch?v=VaIcMlCik1w

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

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

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

Name & Sign of Program Coordinator	Sign & Seal of HoD

Department of Environmental Science

Effective from Session: 2023-2024							
Course Code	**B150406P/ES232**	**Title of the Course**	**Soil Analysis Lab**	**L**	**T**	**P**	**C**
Year	**2nd**	**Semester**	IV	**0**	**0**	**4**	**2**
Pre-Requisite	10+2	**Co-requisite**	NIL				
Course Objectives	This course provides an introduction to the basic laboratory principles. Furthermore, students will have hands on experiments and perform laboratory work in analyzing different parameters of soil.						

Course Outcomes	
CO1	The student will understand about Good Laboratory Practice (GLP).
CO2	The Student will develop practical knowledge on Measurement of different physical parameters of soil
CO3	The Student will develop practical knowledge on qualitative determination of primary nutrient of soil by testing kit
CO4	The student will be able to perform Basic soil microbiology

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Good Laboratory Practices	All Laboratory Rules and Regulations, Safety Precautions, Introduction to Laboratory Instruments, etc.	15	CO1
2	Soil Analysis (Physical Parameters)	Determination of pH, Electrical conductivity, Moisture content, Bulk density of soil	15	CO2
3	Soil Analysis (NPK)	Analysis of Nitrogen, Phosphorus, Potassium content of soil using soil testing kit.	15	CO3
4	Basic Soil Microbiology	Isolation and Enumeration of soil microflora using serial dilution method.	15	CO4

Reference Books:

1. Odum, E.P. (1983), Basic Ecology, Sanders, Philadelphia.

2. The Chemistry of Soils 3rd Edition by Garrison Sposito

3. Practical Manual for Soil, Plant, Water and Seed Testing. P. Gurumurthy

e-Learning Source:

1. https://www.docsity.com/en/environmental-science-environmental-biology-lecture-notes/233205/

2 http://www.rlbcau.ac.in/pdf/Horticulture/HNR%20131%20%20Fundamentals%20of%20Soil%20Science.pdf

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

PO-PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**1**	**1**	**2**	**1**	**1**	**2**	-	-	-	-	-	**3**	**1**	**1**	**1**	**3**	-
CO 2	**3**	**1**	**1**	**1**	**1**	**1**	**2**	-	-	-	-	-	**3**	**1**	**2**	**1**	**3**	-
CO 3	**3**	**1**	**1**	**1**	**1**	**2**	**2**	-	-	-	-	-	**3**	**1**	**2**	**1**	**3**	-
CO 4	**3**	**1**	**1**	**1**	**2**	**1**	**2**	-	-	-	-	-	**3**	**1**	**2**	**1**	**3**	-

3. https://krishi.icar.gov.in/jspui/bitstream/123456789/12719/1/Print-PDF-IIPR-Pocket%20Guide-1-3-2018.pdf

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2023-24							
Course Code	I150407T/ ES233	**Title of the Course**	Environmental Health and Safety	**L**	**T**	**P**	**C**
Year	**2nd**	**Semester**	III	**2**	**1**	**0**	**3**

Pre-Requisite	Basic science	**Co-requisite**	NIL					
Course Objectives	The objective of Environmental Health & Safety course is to equip students with the necessary skills to ensure the health and safety of people and the environment related to working conditions or harmful substances. It helps the students to learn and recognize potential safety concerns before they become big problems. A well-educated student will not only will help in the prevention of catastrophic events, but also understand the importance of the prevention of injury and illness related to safety concerns.							

Course Outcomes

CO1	Define health and its concept
CO2	Describe a public health problem in terms of magnitude, person, time and place.
CO3	Ability to provide industry with inputs on health and safety and understanding of ISO 14001 and its implications for an industry.
CO4	Protocol development for an industry on disaster prevention, health issues, safety measures and environment management.
CO5	Describe the role of social and community factors in both the onset and solution of public health problems

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Concept of health**	Definition- need for good health- factors affecting health. Types of diseases {deficiency, infection, pollution diseases}. Personal hygiene- food (balanced diet). Food habits & cleanliness, food adulterants, avoiding smoking, drugs & alcohols. Work out measures for all situations that could lead to a gradual degradation of the environment.	10	CO1 &2
2	**Communicable diseases and environment**	Public health: communicable diseases, mode of transmission (epidemic and endemic diseases). Management of hygiene in public places (railway stations, bus stands and other public places). Strategic management and planning and tools for implementing health and safety measures. Management of communicable diseases	10	CO, 2& CO5
3	**Non-Communicable diseases and environment**	Definition and concept of NCDs, Lifestyle Diseases-hypertension, diabetes, cancer, heart diseases, and stroke are a part of non-communicable diseases (NCD). Mental health diseases like trauma and depression, Genetic Diseases-Hemophilia, thalassemia, and muscular dystrophy, Down's Syndrome (mutation), Cystic Fibrosis (mutation and inherited), Huntington's chorea (inherited) and Non-communicable Diseases – Prevention and Cure	10	CO2, 3 &5
4	**Occupational health and safety**	Occupational health and safety. Occupational health and hazards-physical-chemical and biological. Occupational diseases- prevention and control. Industrial safety and management techniques: Industrial safety standards and regulations. Accidents-definitions-prevention and control.	10	CO 2,3,4 &5
5	**Health and safety management**	Safety management system- concepts of safety management systems- EMS ISO 14000 and 14001. OSHA, other industry standards like the Golden Sword standard. Behavior based safety programs. Test and monitor industrial health and safety of an industry and suggest remedies to fill gaps in implementation, Principles of accident prevention. Set up measures for altering organizational behavior and risk management	10	CO 4 &5
6	**Activity based**	Identify accident prone areas and adopt methods for reducing accidents following safety precautions, Identify and apply safety policy in an industry and List out the duties and implement Safety Targets, Objectives, Standards, Practices and Performances.	10	CO 1, 2,3,4 &5

Reference Books:

Environmental, Health, and Safety Portable Handbook, Gayle Woodside, 1998, McGraw-Hill Professional

Essentials of Environmental Health (Essential Public Health), by Robert H. Friis | Mar 21, 2018

Environmental Health: From Global to Local (Public Health/Environmental Health) by Howard Frumkin | Feb 29, 2016

Industrial Safety, Health and Environment Management Systems– 1 January 2000 by Prof. Sunil S.Rao & R.K.Jain (Author)

Occupational Safety, Health And Working Conditions Code, 2020 Labour Laws, By Professionals Book Publishers

Occupational Safety and Health: Fundamental Principles and Philosophies, Charles D. Reese, CRC Press

e-Learning Source:

SWAYAM

MOOC

e-SkillIndia

Coursera

Udemy

National Digital Library of India

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1		2			2		3				3		2
CO2	3		2					2	3	2		2	
CO3	2				2			2					2
CO4			3			2		2			2	3	
CO5	3				3	2					3		3

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2023-24							
Course Code	I150408T/ ES234	**Title of the Course**	**Green Technology**	**L**	**T**	**P**	**C**

Year	2nd	Semester	IV	2	1	0	3
Pre-Requisite	10+2	Co-requisite					
Course Objective	To provide different concepts of green technology and green chemistry. To acquire principles of Energy efficient technologies. To impart knowledge on the methods of reducing CO2 levels in atmosphere. To learn the importance of green fuels and its impact on environment. Basic actions to prevent the degradation of the environment and its harmful effects on humans.						

Course Outcomes

CO1	Students are able to understand different concepts of green technology and green chemistry
CO2	Students are able to understand acquire principles of Energy efficient technologies.
CO3	Students are able to understand impart knowledge on the methods of reducing CO2 levels in atmosphere
CO4	Students are able to understand learn the importance of green fuels and its impact on environment.
CO5	Students are able to understand basic actions to prevent degradation of the environment and harmful effects on humans.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to green chemistry and technology	Twelve principles of green chemistry, Green technology-definition, importance, factors affecting green technology. Role of industry, government and institutions; industrial ecology, role of industrial ecology in green technology.	6	CO1
2	Energy Sources	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.	8	CO2
3	Energy Management	Energy management – solar energy input conventional fuels – oil, coal, natural gas, uranium, risk ofnuclear accidents	6	CO3
4	Bio energy	Bio energy – Biomass and bio fuels – Woody biomass for bio fuel - Biogas technology - Petro plants(energy plantations) used for bio fuel – Cellulosic ethanol production	6	CO4
5	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.	8	CO5
6	Cleaner development technologies	Cleaner development mechanisms, role of industry; reuse, reduce and recycle, raw material substitution; wealth from waste; carbon credits, carbon trading, carbon sequestration, eco labelling.	**6**	CO3

Reference Books:

1-Calle FR, de Groot P, Hemstock SL, Woods J (2007) The Biomass Assessment Handbook: Bioenergy for a sustainable environment, Earthscan, UK.

2-El Bassam N (2010) Handbook of Bioenergy Crops – A Complete Reference to Species, Development and Applications, Earthscan, UK

3-Khanal SK, Surampalli RY, Zhang TC, Lamsal BP, Tyagi RD, Kao CM (2010) Bioenergy and Biofuel from Biowastes and Biomass, American Society of Civil Engineers, Virginia, USA.

4-Lee S and Shah YT (2013) Biofuels and Bioenergy: Processes and Technologies, CRC Press, Boca Raton, FL, USA.

e-Learning Source:

https://www.youtube.com/watch?v=AODqoAhTXJA

https://www.youtube.com/watch?v=jo_IRDLLSNU

https://www.youtube.com/watch?v=JABjhJHX8Tc

https://www.youtube.com/watch?v=9opyTo7ZIJY

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	2	2							-	-	-	-	2	1				-
CO2	2	2							-	-	-	-	2	1				-
CO3	2	2							-	-	-	-	1	1				-
CO4	3	2							-	-	-	-	1	1				-
CO5	2	2							-	-	-	-	1	1				-

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

Name & Sign of Program Coordinator	Sign & Seal of HoD

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2023-24							
Course Code	**B150501T/ES314**	**Title of the Course**	**Environmental Microbiology and Biotechnology**	**L**	**T**	**P**	**C**
Year	3rd	**Semester**	V	**4**	**0**	**0**	**4**
Pre-Requisite	10+2 with Physics, Chemistry & Biology	**Co-requisite**	Nil				
Course Objectives	This syllabus provides a comprehensive understanding of environmental microbiology and biotechnology, covering foundational concepts, practical techniques, and real-world applications.						

Course Outcomes

CO1	Get an idea about the historical events in microbiology and biotechnology
CO2	Know concepts related with of microbial ecology and interaction, create a knowledge and understood role of microbes in nutrient cycling, get an idea regarding microbes and their relation with environment
CO3	Know the basic concepts and application of biotechnology in environmental management
CO4	Students will be able to know the molecular techniques involved in environmental microbiology
CO5	Able to explore various uses of microbes for degradation of waste material and ethics in research and application

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Microbiology and Biotechnology	Overview of Microbiology and Biotechnology, Historical development and milestones, Scope and importance in environmental applications	8	CO1
2	Fundamentals of Environmental Microbiology	Microbial diversity in natural environments, Microbial ecology and interactions, Biogeochemical cycles	8	CO2
3	Microbial Physiology and Metabolism	Bacterial structure and function, Metabolic pathways in microorganisms, Microbial growth and control	8	CO2
4	Environmental Biotechnology: Principles and Applications	Basics of biotechnological processes, Applications of biotechnology in environmental management Case studies of successful biotechnological interventions	8	CO3
5	Environmental Microbial Techniques	Sampling and analysis of environmental microorganisms, Microbial identification methods, Molecular techniques in environmental microbiology	8	CO4
6	Bioremediation and Waste Treatment	Principles of bioremediation, Microbial degradation of pollutants, Applications in waste treatment and cleanup	6	CO5
7	Industrial and Agricultural Biotechnology	Microorganisms in industrial processes, Agricultural applications of biotechnology, Genetically modified organisms (GMOs) and their impact	8	CO5
8	Ethical, Legal, and Social Issues in Environmental Biotechnology	Ethical considerations in biotechnological research and applications, Legal frameworks and regulations, public perception and societal impact	6	CO5

Reference Books:

1-Subba Rao NS (2004) Soil Microbiology. 4th Edition, Oxford & IBH Pubilshing Co. Pvt. Ltd., New Delhi.
2-Subba Rao NS (1995) Biofertilizers in Agriculture and Forestry. 3rd Edition, Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
3-Robert LTate (1995) Soil Microbiology. 1st Edition, John Wiley & Sons, Inc. New York.
4-Atlas RN & Bartha R (1998) Microbial Ecology, 4th Edition, Benjamin Cummings.
5-Jogdand SN (2004) Environmental Biotechnology. Reprinted & Published by Himalaya Publishing House, Mumbai.
6-Singh DP & SK Dwivedi (2005). Environmental Microbiology and Biotechnology. 1st Edition, New Age International (P) Ltd., Publishers, New Delhi.

e-Learning Source:

https://onlinecourses.nptel.ac.in/noc21_ce07/preview
https://archive.nptel.ac.in/content/storage2/courses/pmrf/105107173/noc22-ce15_week2.pdf
https://www.pdfprof.com/PDF_Image.php?idt=7868&t=27
https://www.nitttrc.edu.in/nptel/courses/video/105107173/lec2.pdf

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	1	2	1	1	1	2	2	-	-	-	-	2	1	1	1	2	-
CO2	2	1	1	1	1	2	2	2	-	-	-	-	2	1	1	1	2	-
CO3	2	1	1	1	1	2	2	2	-	-	-	-	2	1	1	1	2	-
CO4	2	1	1	1	1	3	2	2	-	-	-	-	2	3	1	1	2	-
CO5	2	1	1	1	1	3	2	2	-	-	-	-	2	3	1	1	1	-

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2023-2024							
Course Code	**B150502P/ ES315**	**Title of the Course**	Environmental microbiology Lab	**L**	**T**	**P**	**C**
Year	3rd	**Semester**	V	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 Physics, chemistry, biology	**Co-requisite**	Nil				
Course Objectives	These lab experiments provide hands-on experience in fundamental techniques of microbiology, allowing students to develop practical skills and understand the relevance of environmental microbiology						

Course Outcomes	
CO1	Apply the scientific knowledge to know the rules and regulation while working in lab and the protocol of sterilization of an instrument.
CO2	Develop practical knowledge about difference between prokaryotic and eukaryotic cells
CO3	Gain knowledge about the general instructions, Microbiology laboratory and its discipline
CO4	Develop knowledge of preparation of medium for culture

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	To know the rules and regulation while working in lab and the sterilization techniques of an instrument	15	CO1
2	Study of cell	To observe the difference between prokaryotic and eukaryotic cells	15	CO2
3	Fundamental of Microbiology	Handling of microscopes, Calibration and measurement of microscopic objects.	15	CO3
4	Media preparation	To know the method of estimation of pH and media preparation for culture	15	CO4

Reference Books:

1-Cappuccino, J. C. and Sherman, N. (1992). Microbiology: A laboratory manual, Addison
2-Wesley Pub. Co Benson HJ (1994).

e-Learning Source:

1-chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.ijsr.net/archive/v4i11/NOV151021.pdf

2-https://chem.libretexts.org/Courses/Brevard_College/CHE_104%3A_Principles_of_Chemistry_II/07%3A_Acid_and_Base_Equilibria/7.07%3A_pH_Calculations_pH_measurement_and_pH_estimation

3-https://pharmastate.academy/dos-donts-in-microbiology lab/#:~:text=Avoid%20coughing%2C%20sneezing%20and%20yawning,unwanted%20articles%20along%20with%20you.

	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**	**1**	**3**	**3**	**2**	**2**						**1**	**3**	**3**	**3**	**3**	-
CO2	**3**	**1**	**2**	**2**	**2**	**3**	**3**						**3**	**2**	**3**	**2**	**1**	-
CO3	**3**	**2**	**3**	**1**	**3**	**2**	**3**						**3**	**3**	**2**	**3**	**2**	-
CO4	**3**	**1**	**2**	**2**	**3**	**2**	**3**						**3**	**2**	**3**	**3**	**2**	-

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Department of Environmental Science
Integral University, Lucknow

Effective from Session: 2023-2024							
Course Code	**B150503T/ ES316**	**Title of the Course**	**Introduction to Physical Environment**	**L**	**T**	**P**	**C**
Year	3rd	**Semester**	V	**4**	**0**	**0**	**4**
Pre-Requisite	10+2 Physics, Chemistry, Biology	**Co-reuisite**	Nil				
Course Objectives	Focusing on the basic physics involved in meteorology and its components, the course aims to develop an understanding of biophysics with energy-budget, radiation-physics, and radioactivity perspectives. Relevant topics related to air pollution, energy fluxes, and radioactivity in the environment (including applications) will develop a holistic overview of the physics involved in the environment, thereby enabling students to apply the concepts of physics in identifying and practicing the field of environmental science.						

Course Outcomes	
CO1	Define the core concepts and methods from ecological and physical sciences and their application in environmental problem-solving.
CO2	Conceptualize meteorology and climatology to differentiate them correctly. Know basic atmospheric elements, their function within the climate system, as well as it's physical and chemical characteristics.
CO3	Develop skills and be able to comprehend the physics involved in the ecological structure and functions with an energy perspective;
CO4	Demonstrate knowledge of atmospheric sciences focusing on wind, clouds, precipitation, storms, radiative balance and climatic change;
CO5	Exhibit conceptual skills and demonstrate knowledge of radiation physics and techniques of physics in environmental analysis;

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Introductory Meteorology**	Introduction, Importance of Meteorology, Basic Metrics, Scientific Notation, Science of Meteorology. The Atmosphere: Origin of the Earth's Atmosphere, Composition of the Atmosphere, Vertical Structure of the Atmosphere, Ozone Layer, Upper Atmosphere	7	CO1
2	**Physical processes**	The Earth in Space, Earth and Sun, Earth-Sun Relationships, Cause of the Seasons, Solar Energy, Greenhouse Effect, Energy Budget of the Earth	6	CO2
3	**Pressure, Density, and Wind**	Pressure Defined, Measurement of Pressure, Vertical Pressure Gradient, Hydrostatic Approximation, Horizontal Pressure Gradient, Isobars and Wind Speeds, Types of winds and Measurement of Wind, Geostrophic Wind, Gradient Wind, Effect of Friction.	6	CO3
4	**Phases of Water**	Humidity Defined, Capacity and Saturation, Dew Point, Vapor Pressure and the Boiling Point, Humidity Parameters, Measurement of Humidity.	6	CO4
5	**Atmospheric Dynamics**	Atmospheric Stability, Environmental Lapse Rate, Dry Adiabatic Lapse Rate, First Criteria for Stability, Most Adiabatic Lapse Rate, Full Stability Criteria, Inversions and Stability. Clouds and Precipitation, Cloud Microstructure, cloud Measurement, Cloud Classification, Formation of Precipitation, Types of Precipitation.	7	CO5
6	**Atmospheric Circulation**	Atmospheric Circulation Systems, Scales of Atmospheric Motion, Global Scale Circulation, Cyclones and Anticyclones, Monsoon Circulation, Small Scale Circulations, Mid-Latitude Low-Pressure Systems, Air-Masses, Development and Evolution of the Wave Cyclone, Upper Atmosphere.	10	CO5
7	**Measuring Instruments and Techniques**	Barometer, hygrometer, anemometer, rain gauge, evaporimeter, thermometry, altimeter, upper air measurement, measuring solar and earth radiation, chart recorder, data logger, conventional measurements of pressure, temperature, humidity, wind, precipitation, visibility, clouds, soil temperature and humidity. Ocean temperature, salinity, wave, height, currents, self-recording instruments radiosondes, radiometer sondes, ozonesonde, LIDARS, SODARS, RADARS: the concept of the amplifier, oscillator, receiver, working principle of radar, different types of radar, radar antenna, PPI display, radar network of IMD, components of radar, the function of radar components, Doppler weather radar, Doppler principle.	10	CO5
8	**Analysis and forecast**	Reading a Weather Map, Observation, Analysis and Prediction, Organization of the National Weather Service, Long-Range Forecasts.	08	CO5

Reference Books:

Physics of the Atmosphere and Climate, Murry L. Salby, Cambridge University Press, 2012.

Introduction to Environmental Physics: Planet Earth, Life and Climate, Peter Hughes & N.J. Mason, CRC press, 2001.

Environmental Physics, Clare Smith, Psychology Press, 2001

James R. Holton and Gregory J. Hakim, An Introduction to Dynamic Meteorology, Academic Press, 2012.

e-Learning Source:

MOOC

SWAYAM

Department of Environmental Science
Integral University, Lucknow

	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
CO1	2	1	1	1	1	1	1	3	1	3	1	1	3	3	3
CO2	2	1	2	1	1	1	1	3	1	3	1	1	3	3	2
CO3	2	1	1	1	1	1	1	3	1	2	1	1	3	3	2
CO4	2	1	1	1	1	1	1	3	1	3	1	1	3	3	3
CO5	2	1	1	1	1	1	1	3	1	2	1	1	3	3	2

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

Name & Sign of Program Coordinator	Sign & Seal of HoD

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2023-2024							
Course Code	**B150504T/ ES317**	**Title of the Course**	**Pollution and Human Health**	**L**	**T**	**P**	**C**
Year	3rd	**Semester**	V	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 Botany, chemistry, physics	**Co-requisite**	Nil				
Course Objectives	This course will enable students to understand environmental problems, looking at causal linkages between pollution sources, exposure pathways and impacts on environmental quality and human health. Students will identify the complex relationships between environmental factors and human health, taking into account multiple pathways and interactions, will be assessed in a broader spatial, socioeconomic, and cultural context. Students will learn how to assess pollution sources, study exposure pathways and fate, and evaluate the consequences of human exposure to pollution and its impacts to environmental quality. Providing the evidence base to support decision and policy making, students should be able to understand pollution problems, consider ways to respond to them, and propose appropriate solutions/actions to reduce (protect, mitigate or prevent) pollution risks when necessary						

Course Outcomes	
CO1	Have gained awareness of current forms of environmental pollution and an overview of both their causes and consequences to natural, economic, and social systems.
CO2	Students understands the fundamental principles governing the interactions between those systems (i.e. transport of pollutants in the environment)
CO3	Have been exposed to learning examples of good practices of technologies and options used to remediate reduce/eliminate pollution of the environment.
CO4	Be able to analyze, synthesize, and evaluate evidence to understand problems and accordingly select control measures and techniques concerning atmospheric, water or terrestrial challenges.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Environmental Pollution	Environmental pollution, types of environmental pollutants, basis and challenges of environmental pollution. Human Health impact and loss of commodity due to Environmental pollution	6	CO1
2	Air pollution	Air Pollution- natural and anthropogenic sources, Types of air pollutants, effects of air pollutants- acid rain, greenhouse effect, and global warming, air pollution control measures. Human Health impact and loss of commodity due to Air pollution. Relevant case studies	8	CO1
3	Water Pollution	Sources of surface and groundwater pollution, water quality parameters and standards, the effect of water contaminants on human health, and Water remediation techniques. Human Health impact and loss of commodity due to water pollution. Relevant case studies	8	CO2
4	Water Treatment Methods and Strategies	Water treatment: Wastewater treatment technologies- Primary, secondary, and tertiary treatments	8	CO3
5	Soil Pollution	Soil pollution: Sources- Industrial, Domestic, Agricultural (Pesticides, heavy metals, industrial effluents, waste disposal), Effects of soil pollutants on plants, animals, and groundwater. Human Health impact and loss of commodity due to soil pollution. Relevant case studies	8	CO4
6	Thermal pollution	Thermal pollution: causes, effects and control measures. Health impact and loss of commodity due to Thermal pollution. Relevant case studies	6	CO4
7	Noise Pollution	Noise Pollution: Sources, sound pressure levels, decibels, intensity and duration, effects of noise pollution on humans and animals, noise permissible standards, noise control measures. Relevant case studies	8	CO5
8	Radioactive pollution	Radioactive pollution: Sources, radioactive elements, effects of radiation on the surrounding environment, Radioactive waste disposal methods. Human Health impact and loss of commodity due to Radioactive pollution. Relevant case studies	8	CO5

Reference Books:

1.Khopkar SM (1993) Environmental Pollution Analysis

2.Saxena HM (2011) Environmental Geography

3. Rao CS (1993) Environmental Pollution Control

e-Learning Source:

1-https://www.frontiersin.org/articles/10.3389/fpubh.2020.00014/full

2-https://www.hindawi.com/journals/jeph/2012/341637/

3-https://www.epa.gov/air-quality-management-process/managing-air-quality-human-health-environmental-and-economic

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	PSO6	PSO7
CO1	2	1	1	1									2	2	2	2		
CO2	2	1	1	1									2	2	2	2		
CO3	2	1	1	1									2	2	2	2		
CO4	2	1	1	1									2	2	2	2		
CO5																		

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2023-24							
Course Code	**ES150505T/ES318**	**Title of the Course**	**Energy and its Management**	**L**	**T**	**P**	**C**
Year	**3rd**	**Semester**	V	**4**	**0**	**0**	**4**
Pre-Requisite	10+2 with science	**Co-requisite**	Nil				
Course Objectives	To understand the Introduction and history related to different forms of energy. To provide knowledge of Energy resources and its demand as respect to historical and current perspectives. To develop knowledge of Energy consumption and its impact on environment. To provide knowledge of Policies for uses of energy. To provide deep knowledge of sustainable use of energy.						

Course Outcomes	
CO1	Be able to describe history related to different forms of energy.
CO2	Be able to Illustrate Energy resources and its demand as respect to historical and current perspectives.
CO3	Be able to explain Energy consumption and its impact on environment
CO4	Be able to make connections of Policies for uses of energy
CO5	Have an enhanced knowledge of sustainable use of energy.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	Defining energy, forms and importance, energy use from a historical perspectives, Discovery of fire, discovery of locomotive engine and fossil fuels, electrification of cities, Oil wars in Middle east, advent of nuclear energy, Sources and sinks of energy.	8	CO1
2	Energy resources and Demands	Global energy resources, renewable and non renewable resources, Energy use scenarios in rural and urban setups, Global energy demand, historical and current perspectives, energy demand and use in domestic, industrial, agricultural and transportation sector, generation and utilization in rural and urban environments, energy subsidies and environmental costs.	8	CO2
3	Energy, Ecology and theenvironment	Energy production as driver of environmental change, energy production, transformation and utilization associated environmental impacts (Chernobyl and fukushima nuclear accidents, construction of dams, environmental pollution), energy over consumption and its impacts on the Environment.	8	CO3
4	Politics of energy policy	Political choices in energy policy globally and in the Indian context (Historical and contemporary case studies), domestic and international energy policy, energy diplomacy and bileteral ties of India with its neighbors.	6	CO4
5	Our Energy Future	Current and future energy use patterns in the world and in India, evolution of energy use over time, alternative sources as green energy, need of energy efficiency, energy conservation and sustainability, action strategies for sustainable energy mix and management from a future perspective.	8	CO5
6	Solar Radiation And Its Measurement	Sun as source of energy, nature of its radiation, heat budget of the earth, earth's temperature and atmosphere. Solar radiation measurements.	6	CO1
7	Environmental Aspects Of Energy And Protocols	Concept of sustainable development, Concern over climate change, UNFCC, IPCC, Kyoto protocol: emission trading, Joint implementation, CDM case studies. Environmental policy of the government of India and the working of Ministry of Environment and Forests	8	CO3
8	Ecofriendly Technologies	Various applications of eco-friendly biosensors, biogas, bioethanol and biofuel Development and application of eco-friendly and cost-effective tools in environmental pollution management and agricultural activities, Green design, building and infrastructure .	8	CO5

Reference Books:

1-McK ibbeli, B. 2012.Global Warming's Terrifying New Math, Rolling Stone Magazine.

2-Rowlands, I.H. 2009. Renewable Electricity.'The Prospects for Innovation and Integration in Provincial Policies in Debora L. Van Nijnatteii and Robert Boardmanl (eds), Canadian.

3-Environmental Policy and Politics: Prospects for Leadership and Innovation, Third Edition. Oxford University Press, pp. l 67-82.

4-Oliver, J. 2013. Dispelling the Myths about Canada's Energy Futilre, Policy: Canadian Politics and Public Policy, June-July.

5-Malton, K. 2006. Myths, Pitfalls arid Oversights, Renewable Energy Policy and Politics: A Handbook for Decision Making- Earth Scan.

e-Learning Source:

https://docs.google.com/document/d/1ud7CjOPqPqTj_4nvdj8uZFHsXWCPh03J/edit?usp=sharing&ouid=114555250431858417199&rtpof

https://www.youtube.com/watch?v=EM1IyIyr-Zc

https://www.youtube.com/watch?v=-RSrviqvAmY

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	2	2	2	2	2	2	2	-	-	-	-	-	2	1	1	2	1	-
CO2	2	2	2	2	2	3	2	-	-	-	-	-	2	3	2	2	2	-
CO3	2	2	3	3	3	2	2	-	-	-	-	-	2	2	3	2	3	-
CO4	1	2	2	2	2	2	2	-	-	-	-	-	2	2	2	2	2	-
CO5	1	2	2	2	2	2	2	-	-	-	-	-	2	2	1	2	2	-

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2023-24							
Course Code	**B150506P/ES319**	**Title of the Course**	**Energy Lab**	**L**	**T**	**P**	**C**
Year	**3rd**	**Semester**	V	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 Physics, Chemistry, Botany	**Co-requisite**	Nil				
Course Objectives	This course provides students with a working knowledge of utilization and importance of non-conventional energy resources						

Course Outcomes	
CO1	Students will able to calculate the efficiency of Solar photovoltaic panel (PV) by I-V curve.
CO2	Students will able to determine the power generated by Wind turbine using I-V curve w.r.t. distance of rotor generator from the source of wind
CO3	Students will learn about Biogas production by Anaerobic Digester.
CO4	Students will able about the Synthesis and determination of Biodiesel from vegetable oil by transesterification method.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Calculation of Efficiency of PV panel	To calculate the efficiency of Solar photovoltaic panel (PV) by I-V curve	15	CO1
2	Determination of Power generation	To determine the power generated by Wind turbine using I-V curve w.r.t. distance of rotor generator from the source of wind	15	CO2
3	Biogas Production	Biogas production by Anaerobic Digester	15	CO3
4	Synthesis and Determination of Biodiesel	Synthesis and Determination of Biodiesel from vegetable oil by transesterification method	15	CO4

Reference Books:

- W. Kurge: ISO 14001 Certification – Environmental Management System, Prentice Hall, 1995
- Power plant engineering, P.K. Nag, McGraw-Hill
- Rai, G.D. Non Conventional Energy Sources. Khanna Publishers, New Delhi. 1998.
- Flowler, John M., "Energy and the Environment", 2nd Edition, McGraw Hill, New York, 1984.
- Carless, Jennifer, "Renewable Energy: A Concise Guide to Green Alternative", Walker, New York, 1993.

- W. Kurge: ISO 14001 Certification – Environmental Management System, Prentice Hall, 1995
- Power plant engineering, P.K. Nag, McGraw-Hill

e-Learning Source:

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

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

Name & Sign of Program Coordinator	**Sign & Seal of HOD**

Integral University
Department of Environmental Science

Effective from Session:2023-2024							
Course Code	**B150509R/ ES320**	**Title of the Course**	**Internship/Apprenticeship, (Research Project I)**	**L**	**T**	**P**	**C**
Year	**3rd**	**Semester**	V	**0**	**0**	**0**	**3**
Pre-Requisite	10+2 Physics, Chemistry, Biology, Computer Science	**Co-requisite**	Nil				
Course Objectives	Upon finishing the course students will be able to come up with a gain of professional work in industry and research project experience.						

Course Outcomes	
CO1	To apply theoretical concepts learned in degree course work to a practical situation
CO2	To obtain experience with relevant materials and methodologies.
CO3	Achieve/complete assigned target(s)/ task(s) given by the person to whom the intern or apprentice is reporting (Supervisor)

Unit No.	**Title of the Unit**	**Content of unit**	**Mapped CO**
1	Internship/Apprenticeship (Research Project I)	Students are encouraged to undergo summer/winter in plant training in a suitable industry, consultancy, research laboratory, institute, Protected Areas etc. so as to get firsthand experience of corporate environmental management and of natural habitat. Candidates will write a field project report on issues related to Environmental Science under the guidance of their respective guides. Each student will work independently on the topic. The field project must consist of a review of the literature and produce a deep insight of the subject based on personal research. Field project work will be initiated at the start of Semester. The students will undertake fieldwork in terms of the collection of data and surveys. The field project will have to be submitted for appraisal and acceptance by the University. The students should submit their field project report in the following format: Chapter I: Introduction with Aims and Objectives: A background with historical information and a review of existing material or data on the subject along with the aims and objectives of the study. Chapter II: Methodology with Material and Methods: Description of the issue, methodology adopted for the study. Chapter III: Experimental: Presentation of data collected and detailed analysis of results. Chapter IV: Result and Discussion: Discussion on the data and results obtained and Presentation of method suggested to solve the problem. Chapter V: Summary and Conclusions: A summary of the dissertation and important conclusions drawn at the end of the investigation. Bibliography or References: A list of references cited in the text. The Field Project Report should be typed on A4 size bond paper with 1.5 line spacing. Illustrations and photographs should be of high quality. The report should be flawless without any spelling mistakes or grammatical errors. Students will have to submit their field project report one month Before the practical examination at the end of Semester. The field work report will carry 100 marks (Internal marks 20 and External marks 80). Assessment of the report will be done at the end of the year. Students have to present a Power Point Presentation. Assessment of the field work shall be done by the external examiner appointed by HOD, Integral University.	CO1,2,3,

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

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

Name & Sign of Program Coordinator	**Sign & Seal of HOD**

Department of Environmental Science
Integral University, Lucknow

Effective from Session: 2023-2024							
Course Code	**B150601T/ ES321**	**Title of the Course**	**Environmental Legislation and Impact Assessment**	**L**	**T**	**P**	**C**
Year	**3rd**	**Semester**	VI	**4**	**0**	**0**	**4**
Pre-Requisite	10+2 Law, Botany, Chemistry	**Co-requisite**	Nil				
Course Objectives	The course has two major components of Environmental Science: Law and EIA. The course is designed to impart knowledge to students about the history of the constitution of India and the importance and implementation of environmental laws. It will help the students to analyze the significance and compliance of laws in the Indian set-up. This course also provides a basic understanding of the EIA process as it is used for research, planning, project or program evaluation, monitoring, and regulatory enforcement. Introduce students to the legal, economic, administrative, and technical process of preparing and/or evaluating environmental impact documents. To relate the uses of scientific research to practical situations in project planning and decision-making.						

Course Outcomes	
CO1	Define the Indian constitutional provisions concerning environmental protection, division of powers, and fundamental rights and have an in-depth knowledge of the processes associated with EIA
CO2	Classify and know the origins, needs, and sources of environmental laws, and understand how and by whom environmental laws are made and deduced.
CO3	Develop skills and the ability to describe the complex social, scientific, and humanistic purview of environmental issues about the laws of the country
CO4	Have the ability to identify the potential impacts of proposed developments and propose solutions to address these impacts in a range of contexts.
CO5	Review the EIA process and the regulatory frameworks in which EIA operates in a range of countries

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Introduction and History of Environmental Law**	Constitution of India; fundamental rights; fundamental duties; Union of India; union list, state list, concurrent list; legislature; state assemblies; judiciary; panchayats and municipal bodies. Provision of Environmental Conservation - British India: Indian Penal Code 1860, Forest Act 1865, Fisheries Act 1897; Independent India: Van Mahotsava 1950, National Forest Policy 1952, National Forest Policy 1988.	6	CO 1
2	**Directive Principles**	Legal definitions (environmental pollution, natural resource, biodiversity, forest, sustainable development); Article 48A (The protection and improvement of environment and safeguarding of forests and wildlife); Article 51 A (Fundamental duties).	4	CO 2
3	**Environmental Legislation in India**	The Indian Forest Act 1927; 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 Forests (Conservation) Act 1980; The Air (Prevention and Control of Pollution) Act 1981; The Environment (Protection) Act 1986; Motor Vehicle Act 1988; The Public Liability Insurance Act 1991; Noise Pollution (Regulation and Control) Rules 2000; The Biological Diversity Act 2002; The Schedule Tribes and Other Traditional Dwellers (Recognition of Forests Rights) Act 2006; The National Green Tribunal Act 2010; scheme and labeling of environment-friendly products, Eco marks	10	CO2&CO3
4	**Role of Government Institutions, National & International Policies**	Role of Ministry of Environment, Forests & Climate Change in environmental law and policy-making; role of central and state pollution control boards in environmental law and policy-making; National Green Tribunal; National Environment Policy, 2006. Stockholm Conference 1972; United Nations Conference on Environment and Development 1992; Rio de Janeiro (Rio Declaration, Agenda 21); Montreal Protocol 1987; Kyoto Protocol 1997; Copenhagen and Paris summits; Ramsar convention.	8	CO2 &CO3
5	**Introduction to EIA**	Environmental impact assessment (EIA): definitions, introduction, and concepts; rationale and historical development of EIA; scope and methodologies of EIA; role of project proponents, project developers and consultants; Terms of Reference; impact identification and prediction; baseline data collection; Environmental Impact Statement (EIS), Environmental Management Plan (EMP)	6	CO 4
6	**India's Status & Rapid EIA**	EIA regulations in India; status of EIA in India; current issues in EIA; case study of hydropower projects! thermal projects. Strategic Environmental Assessment; Social Impact Assessment; Cost-Benefit analysis; Life cycle assessment; environmental appraisal; environmental management - principles, problems and strategies; environmental planning; environmental audit; introduction to ISO and ISO	8	CO 4

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		14000; sustainable development.		
7	**Risk assessment**	Introduction and scope; Project planning; Exposure assessment; Toxicity assessment; Hazard identification and assessment; Risk characterization; Risk communication; Environmental monitoring; Community involvement; Legal and regulatory framework; Human and ecological risk assessment. Review of different Case studies on Environmental Laws and EIA.	8	CO 5
8	**Case studies**	Relevant Case studies related to environmental conservation via laws and Environmental Impact Assessments case studies	10	CO5

Reference Books:

1. Divan S. and Rosencranz A. (2005) Environmental Law and Policy in India, 2nd ed., Oxford, New Delhi
2. Leelakrishnan P. (2008) Environmental Law in India, 3rd ed., Lexis Nexis, India
3. Armin Rosencranz - Environmental Law and Its Policy in India.
4. P. Leelakrishnan - Environmental Law in India /Cases.
5. Birnie P. (2009) et al., International Law and the Environment, 3rd ed., Oxford.
6. Environmental Impact Assessment, L. W. Canter, Mc Graw Hill, New York, 1996.
7. Handbook of Environmental Impact Assessment Vol I and II, J. Petts, Blackwell Science, London, 1999.
8. The Theory and the Practice of Environmental Impact Assessment, S. A. Abbasi and N. Ramesh, DPH, New Delhi, 2003.
9. Complete Guide to ISO 14000, R. B. Clements. Simon & Schuster, 1996.
10. Environmental Management, Kulkarni, V. and Ramachandra T.V., Capitol Pub. Co., New Delhi. 2006
11. Handbook of Environmental Impact Assessment, Petts, J. - Volume 1 and 2. Blackwell Publishers, UK 2005.
12. Introduction to Environmental Impact Assessment, Glasson, J. Therivel, R. and Chadwick, A. Routledge, London. 2006

e-Learning Source:

MOOC

SWAYAM

EIA reports for various sectors are available on the official website of the Ministry of Environment and Forest (www.envfor.nic.in)

EIA Manuals prepared by ASCI and IL & FS on the official website of the Ministry of Environment and Forest (http://environmentclearance.nic.in/)

Standard terms of reference [TOR] for EIA / EMP report for projects/activities requiring environment clearance under EIA notification, 2006 (http://moef.gov.in/sites/default/files/final%20Booklet.pdf)

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

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

Department of Environmental Science
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Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2023-2024							
Course Code	**B150603P/ ES322**	**Title of the Course**	**Practical on EIA, Biostatistics, and Computer Applications**	**L**	**T**	**P**	**C**
Year	**3rd**	**Semester**	VI	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 Law, Botany, Chemistry	**Co-requisite**	Nil				
Course Objectives	Upon successful of this Lab. course students should be able to know about process of EIA, calculation of Mean, Median & Mode, Graphical representation of data & Applications in Statistics and EIA Case Studies.						

Course Outcomes	
CO1	Students will be able to understand about process of EIA
CO2	Students will be able to study about calculation of Mean, Median & Mode
CO3	Students will be able to study about Graphical representation of data & Applications in Statistics
CO4	Students will be able to study about EIA Case Studies

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	EIA	To study about EIA process	15	CO1
2	Biostatistics	To Study about calculation of Mean from a given Data To Study about calculation of Median from a given Data To Study about calculation of Mode from a given Data	15	CO2
3	Computer Applications	To study about Graphical representation of data & Applications in Statistics	15	CO3
4	Application of EIA by Case Studies	To study about EIA Case Studies	15	CO4

Reference Books:

1. Introduction to Biostatistics By S Chand

2. Environmental Impact Assessment Handbook: A practical guide for planners, developers and communities, Third edition by Barbara Carroll, Josh Fothergill, Jo Murphy and Trevor Turpin

3. Practical Statistics for Data Scientists by Peter Bruce, Andrew Bruce

e-Learning Source:

https://www.youtube.com/watch?v=5OEDrvFjCME

https://www.youtube.com/watch?v=3F_V5alJubk

https://www.youtube.com/watch?v=co9G_-L3_7U

https://www.youtube.com/watch?v=K5ikiXyqOgw

	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	PSO4	PSO5	PSO6	PSO7
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session:2023-2024							
Course Code	**B150602T/ES323**	**Title of the Course**	**Environmental Priorities and Research Tools**	**L**	**T**	**P**	**C**
Year	3rd	**Semester**	VI	**3**	**1**	**0**	**4**
Pre-Requisite	10+2, Chemistry, Biology, Geography	**Co-requisite**	Nil				
Course Objectives	This course provides students environmental movements, priorities with working knowledge of Basic Analysis methods and principles of related Instruments						

Course Outcomes	
CO1	Learn about general national environmental movements and Rivers Action Plans, Sustainable development and Human Health.
CO2	Develop understanding about different environmental disasters and their management.
CO3	Students will be able to understand about Chemical & Biological hazards.
CO4	Able to understand the environmental priorities in India. Students will learn about increase in population growth, its impact on environment and welfare programs.
CO5	Developed skills about environmental sampling& analysis Techniques.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	National Environmental movement and River Plans	Silent valley movement, Chipko movement, Narmada movement, Green Revolution, Appiko movement, Tehri Dam movement; Namami Gange and Yamuna Action Plan; International Solar Alliance.	8	CO1
2	Environmental Priorities in India**:**	Sustainable Development; Urban and Rural planning, Power generation; Human Population Explosion; Environment and human health; Sanitation and health education; Role of information technology in environment and human health	8	CO1
3	Environmental Disaster	Natural hazards; earthquake, flood, cyclones,landslides, desertification and fire; Resettlement and rehabilitation process; NDRF/SDRF; NDMA	8	CO2
4	Environmental Toxicology	Environmental Toxicants, Water borne pathogens and diseases, Pesticides and heavy metal toxicity, Bioindicators	6	CO3
5	Environmental Approaches	Population growth, variation among nations, Need for gender equity, Population explosion - Family Welfare Programme. Human Rights and Value Education. National Green Tribunal.	8	CO4
6	Environmental research methodology	Concept of secondary and primary data sources. Spatial and non-spatial data. Environmental sampling: sampling designs, sampling types, representative samples – its characteristics. Sampling errors, calibration. Concept of control, blank and standards. Concept of detection limits.	8	CO4
7	Environmental sampling & Analysis	Environmental sampling techniques - air, water, soil, noise, aquatic and soil biota. Sample handling, transportation and preservation.	6	CO5
8	Instrumentation Analysis	Introduction to Techniques, Basic principles, and applications- Centrifuge, Titration, pH meter Conductivity meter, Nephelometry; Gravimetry; Microscopy; Ultraviolet-visible (UV-VIS) Spectroscopy, Flame photometry	8	CO5

Reference Books:

1)Agarwal, K.C. 2001 Environmental; Biology, Nidi Pub. Ltd. Bikaner.

2) Methods in Environmental Analysis: Water,Soil and Air. PK Gupta

3) Disaster Management and Preparedness. Nidhi Dhawan and Ambrina Sardar Khan

4) Hand Book of Analytical Instruments 2006 McGraw-Hill Education Private Limited

e-Learning Source:

https://www.standardsmedia.com/Instrumentation-1109-mc.html.

https://byjus.com/free-ias-prep/disaster-management-india/

https://byjus.com/free-ias-prep/disaster-management-india/

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

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session:2023-2024							
Course Code	**B150602T/ES323**	**Title of the Course**	**Environmental Priorities and Research Tools**	**L**	**T**	**P**	**C**
Year	3rd	**Semester**	VI	**3**	**1**	**0**	**4**
Pre-Requisite	10+2, Chemistry, Biology, Geography	**Co-requisite**	Nil				
Course Objectives	This course provides students environmental movements, priorities with working knowledge of Basic Analysis methods and principles of related Instruments						

Course Outcomes	
CO1	Learn about general national environmental movements and Rivers Action Plans, Sustainable development and Human Health.
CO2	Develop understanding about different environmental disasters and their management.
CO3	Students will be able to understand about Chemical & Biological hazards.
CO4	Able to understand the environmental priorities in India. Students will learn about increase in population growth, its impact on environment and welfare programs.
CO5	Developed skills about environmental sampling& analysis Techniques.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	National Environmental movement and River Plans	Silent valley movement, Chipko movement, Narmada movement, Green Revolution, Appiko movement, Tehri Dam movement; Namami Gange and Yamuna Action Plan; International Solar Alliance.	8	CO1
2	Environmental Priorities in India**:**	Sustainable Development; Urban and Rural planning, Power generation; Human Population Explosion; Environment and human health; Sanitation and health education; Role of information technology in environment and human health	8	CO1
3	Environmental Disaster	Natural hazards; earthquake, flood, cyclones,landslides, desertification and fire; Resettlement and rehabilitation process; NDRF/SDRF; NDMA	8	CO2
4	Environmental Toxicology	Environmental Toxicants, Water borne pathogens and diseases, Pesticides and heavy metal toxicity, Bioindicators	6	CO3
5	Environmental Approaches	Population growth, variation among nations, Need for gender equity, Population explosion - Family Welfare Programme. Human Rights and Value Education. National Green Tribunal.	8	CO4
6	Environmental research methodology	Concept of secondary and primary data sources. Spatial and non-spatial data. Environmental sampling: sampling designs, sampling types, representative samples – its characteristics. Sampling errors, calibration. Concept of control, blank and standards. Concept of detection limits.	8	CO4
7	Environmental sampling & Analysis	Environmental sampling techniques - air, water, soil, noise, aquatic and soil biota. Sample handling, transportation and preservation.	6	CO5
8	Instrumentation Analysis	Introduction to Techniques, Basic principles, and applications- Centrifuge, Titration, pH meter Conductivity meter, Nephelometry; Gravimetry; Microscopy; Ultraviolet-visible (UV-VIS) Spectroscopy, Flame photometry	8	CO5

Reference Books:

1)Agarwal, K.C. 2001 Environmental; Biology, Nidi Pub. Ltd. Bikaner.

2) Methods in Environmental Analysis: Water,Soil and Air. PK Gupta

3) Disaster Management and Preparedness. Nidhi Dhawan and Ambrina Sardar Khan

4) Hand Book of Analytical Instruments 2006 McGraw-Hill Education Private Limited

e-Learning Source:

https://www.standardsmedia.com/Instrumentation-1109-mc.html.

https://byjus.com/free-ias-prep/disaster-management-india/

https://byjus.com/free-ias-prep/disaster-management-india/

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

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2023-2024							
Course Code	**B150605T/ ES325**	**Title of the Course**	**Environmental Monitoring and Modelling**	**L**	**T**	**P**	**C**
Year	**3rd**	**Semester**	VI	**4**	**0**	**0**	**4**
Pre-Requisite	10+2 with Science	**Co-requisite**	Nil				
Course Objectives	This course aims to provide an introduction to the fundamental monitoring & modeling concepts, and their applications in simulating pollution monitoring and resource utilization in natural environmental systems. The tools and techniques help in investigating, understanding, representing the current, and predicting the future state of the environment.						

Course Outcomes	
CO1	Recall basic concepts and principles of environmental monitoring.
CO2	Summarize definitions of sample, its types etc. Explain various steps and precautions required before sampling of soil, water, air etc.
CO3	Understand the different modeling approaches, their scope and limitations
CO4	Become aware of a wide range of applications of modelling in environmental management & decision-making.
CO5	To understand the basic principle and application of instruments.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Basics of Environmental Monitoring	What is environmental quality? Quality of environment for life on earth and man; Advantages of Environmental Monitoring, Deterioration of environmental quality concerning anthropogenic impact; Methods of assessment of environmental quality; Short-term studies/surveys; Rapid assessment; Continuous short- and long-term monitoring	8	CO1
2	Water Monitoring	Objectives of water monitoring, Collection of samples, sample preservation, Physical, chemical, and biological parameters of water & its monitoring, General effluent standards, stream standards Drinking water standard (IS10500 and WHO Standards),	8	CO2
3	Air Monitoring	Air sampling: types, techniques, Site and parameter selection, National standards for ambient air quality, monitoring of particulate matter, SOx and NOx, Ambient and stack air monitoring techniques, Air Monitoring tools/instruments used for air its work principle	6	CO2
4	Soil Monitoring	Objectives of soil monitoring/testing, Types of soil sampling and sample units, Site selection, Important soil quality indicators Instruments/equipment used in soil monitoring	6	CO2
5	Introduction	Environmental modeling: scope and problem definition, goals and objectives, definition; modeling approaches– deterministic, stochastic and the physical approach; applications of environmental models; the model building process	8	CO3
6	Concept of Environmental Modelling	Introduction to environmental system analysis; Approaches to the development of models, linear simple and multiple regression models; Validation and forecasting Modelling techniques; Model performance, accuracy and utilization	8	CO4
7	Environmental Modelling Applications	Water quality modeling: surface water quality modeling – lakes and impoundments, rivers; groundwater pollution modeling Air quality modeling: the box model, the Gaussian plume model point sources, line sources, area sources; special topics; Gaussian puff model	8	CO4&5
8	Instruments in Environmental Monitoring	pH meter, Conductivity meter, Colorimeter, UV Spectrophotometer, Atomic absorption spectrophotometer, Flame photometer, Hot air oven, autoclave, laminar flow, RSPM 2.5, Gas chromatography, Mass spectroscopy, Scanning electron microscopy	8	CO5

Reference Books:

1-Handbook of Methods in Environmental Studies: Vol.1 By Maiti, Subodh. (2003).

2-Handbook of Methods in Environmental Studies: Vol 2 (Air, noise, soil and overburden analysis). By Maiti, Subodh. (2003).

3-Fundamentals of Environmental Pollution, Krishnan Khannan, S. Chand and Company Ltd., 1994.

4-Maity, S.K. 2014. Handbook of Methods in Environmental Studies Vol-I & II. Oxford Book Company, New Delhi

5-Gupta, P.K. 2011. Methods in Environmental Analysis: Water, Soil, Air (2nd Edition) Vatsal Enterprises, New Delhi

6-Trivedy, R.N. 2002. A Text Book of Environmental Pollution and Control. Anmol Publication, New Delhi.

7-Ramaswami A., Milford J.B. and Small M.J. (2005) Integrated Environmental Modelling, John Wiley and Sons, Inc., New Jersey.

8-Schnoor J.L. (1996) Environmental Modeling, John Wiley & Sons, Inc., New York.

e-Learning Source:

SWAYAM, MOOC, NPTEL

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	PSO4	PSO5	PSO6	PSO7
CO1	1	2	2	3	3	3	3						1	1	1	1		
CO2	3	2	3	3	3	3	2						1	2	2	2		
CO3	1	1	2	2	2	3	3						3	3	2	1		
CO4	3	3	3	3	3	3	3						1	2	2	2		
CO5	2	2	2	1	1	1	1						3	3	2	2		

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2023-2024							
Course Code	**B150606P/ ES326**	**Title of the Course**	**Environmental monitoring Lab**	**L**	**T**	**P**	**C**
Year	**3rd**	**Semester**	VI	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 with Science	**Co-requisite**					
Course Objectives	The course is designed to develop sampling and analytical skills of the students which are required in environmental monitoring. The students will be exposed to various standard protocols used in environmental monitoring.						

Course Outcomes	
CO1	Students will be trained in analytical and conceptual skills required for soil analysis.
CO2	Students will be trained in analytical and conceptual skills required for water analysis.
CO3	Students will be trained in analytical and conceptual skills required for air monitoring.
CO4	Students will be expert in instrumental experiment of environmental monitoring.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Soil monitoring**	Analysis of soil moisture content by oven dry method. Determination of electrical conductivity of soil sample.	15	CO1
2	**Water monitoring**	Determination of total alkalinity of water sample. Determination of chloride content of water sample.	15	CO2
3	**Air monitoring**	Determination of physical composition and characteristics of municipal solid waste. Analysis of nitrogen dioxide (NO2) and suspended particulate matter (SPM) in air	15	CO3
4	**Environmental Monitoring Instrument**	pH meter, Conductivity meter, Colorimeter, UV Spectrophotometer, Atomic absorption spectrophotometer, Flame photometer, Hot air oven, autoclave, laminar flow, RSPM 2.5, Gas chromatography, Mass spectroscopy, Scanning electron microscopy	15	CO4

Reference Books:

Radojevic M. and Valdimir N.B. (2006) Practical Environmental Analysis, RSC publishing

APHA (1980) Standard Methods for the Examination of Water and Wastewater Published by American Public Health Association, 15th ed.

Wagner T.P. and Robert S. (2009) Environmental Science: Active Learning Laboratories and Applied Problem Sets, 2nd Edition, Wiley.

Wells E. (2009) Lab Manual for Environmental Science, Cengage Learning

e-Learning Source:

SWAYAM

MOOC

NPTEL

	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	PSO4	PSO5	PSO6	PSO7
CO1	1	3	3	3	1	1	2						1	1	3	1		
CO2	1	3	3	3	1	1	2						1	1	3	1		
CO3	1	3	3	3	1	1	2						1	1	3	1		
CO4	1	3	3	3	1	1	2						1	1	3	1		

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Department of Environmental Science
Integral University

Effective from Session:2023-2024							
Course Code	**B150607R/ ES327**	**Title of the Course**	**Internship/Apprenticeship, (Research Project III)**	**L**	**T**	**P**	**C**
Year	3rd	**Semester**	VI	**0**	**0**	**0**	**3**
Pre-Requisite	10+2 Botany, Physics, Chemistry	**Co-requisite**	Nil				
Course Objectives	Upon finishing the course students will be able to come up with a gain of professional work in industry and research project experience.						

Course Outcomes	
CO1	To apply theoretical concepts learned in degree course work to a practical situation
CO2	To obtain experience with relevant materials and methodologies.
CO3	Achieve/complete assigned target(s)/ task(s) given by the person to whom the intern or apprentice is reporting (Supervisor)

Unit No.	**Title of the Unit**	**Content of unit**	**Mapped CO**
1	Internship/Apprenticeship (Research Project I)	Students are encouraged to undergo summer/winter in plant training in a suitable industry, consultancy, research laboratory, institute, Protected Areas etc. So as to get firsthand experience of corporate environmental management and of natural habitat. Candidates will write a field project report on issues related to Environmental Science under the guidance of their respective guides. Each student will work independently on the topic. The field project must consist of a review of the literature and produce a deep insight of the subject based on personal research. Field project work will be initiated at the start of Semester. The students will undertake fieldwork in terms of the collection of data and surveys. The field project will have to be submitted for appraisal and acceptance by the University. The students should submit their field project report in the following format: Chapter I: Introduction with Aims and Objectives: A background with historical information and a review of existing material or data on the subject along with the aims and objectives of the study. Chapter II: Methodology with Material and Methods: Description of the issue, methodology adopted for the study. Chapter III: Experimental: Presentation of data collected and detailed analysis of results. Chapter IV: Result and Discussion: Discussion on the data and results obtained and Presentation of method suggested to solve the problem. Chapter V: Summary and Conclusions: A summary of the dissertation and important conclusions drawn at the end of the investigation. Bibliography or References: A list of references cited in the text. The Field Project Report should be typed on A4 size bond paper with 1.5 line spacing. Illustrations and photographs should be of high quality. The report should be flawless without any spelling mistakes or grammatical errors. Students will have to submit their field project report one month Before the practical examination at the end of Semester. The field work report will carry 100 marks (Internal marks 20 and External marks 80). Assessment of the report will be done at the end of the year. Students have to present a Power Point Presentation. Assessment of the field work shall be done by the external examiner appointed by HOD, Integral University.	CO1,2,3,

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

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

Name & Sign of Program Coordinator	**Sign & Seal of HOD**