

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 |
|---|-------------------------------|



| 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. |
| | |

| |
|--|
| 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/TADfGgai3Ro . |
| 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 . |

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 | 1 st | 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 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 6 | PSO 7 |
| 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 . | |

| PO- PSO CO | Course Articulation Matrix: (Mapping of COs with POs and PSOs) | | | | | | | | | | | | | | | | | |
|------------------|--|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|------|------|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 | 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

Received from Session:2023-2024

| Course Code | I150106T/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 | I150107T/ES132 | Title of the Course | Water Monitoring and Conservation Techniques | L | T | P | C |
| Year | 1 st | 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 | Cont act 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 Wiley 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, Udemmy, 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

Effective from Session: 2023-2024

| | | | | | | | |
|-------------------|--|---------------------|-----------------------|---|---|---|---|
| Course Code | B150201T/ES133 | Title of the Course | Environmental Biology | L | T | P | C |
| Year | First | Semester | Second | 3 | 1 | 0 | 4 |
| Pre-Requisite | 10+2 with Physics, Chemistry & (Maths/ Biology) | Co-requisite | | | | | |
| Course Objectives | This course introduces the basic principles of Environmental biology, ecology, and the relationship between humans and natural world. This major course is designed to provide students with a foundation in population, whole organism, evolutionary biology and environmental science as well as in chemistry and mathematic | | | | | | |

Course Outcomes

| | |
|-----|---|
| CO1 | The student will be to understand the basic elements of ecology and environmental factors and ecosystem dynamics. |
| CO2 | The course will lead the students understand the different functions played by ecosystem and its various positive and negative interactions with organisms. |
| CO3 | Develop understanding about Evolutionary Theories, Ecological Succession and Taxonomy. |
| CO4 | Ability to realize the usefulness of flora and fauna for pollution control mechanism. |
| CO5 | Students will study about the growth of different types of microorganisms based on various environmental factors |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|----------|---------------------------------|--|--------------|-----------|
| 1 | Ecology | Introduction of Ecology (Definition, History, Branches and Scope). Basic principles of Environment and Ecology; Environmental factors (Abiotic and biotic) their importance and role. | 8 | CO1 |
| 2 | Ecosystem | Components, Structure, and function of Ecosystem; Major ecosystems (terrestrial, aquatic, and marine); Trophic Levels, food chain and food webs; Energy flow in Ecological systems; Ecological Pyramids, Productivity. | 8 | CO2 |
| 3 | Autecology | Population Characteristics- Dispersion, Density, Natalty, Mortality, Age Structure, Population Growth; Human population & growth; Ecological niche and habitat; Positive and Negative Interactions of Populations. | 6 | CO2 |
| 4 | Synecology | Community Structure, Growth Forms; Methods of Plant Community Analysis; Concept of Keystone Species, Ecotone, Ecotypes, Ecophene, ecological indicators; Ecological Succession. | 8 | CO3 |
| 5 | Biogeochemical Cycles | Hydrological, Gaseous and Sedimentary Cycle- Carbon, Oxygen, Nitrogen, Phosphorus and Sulphur Cycles; Major biome of the world. | 6 | CO4 |
| 6 | Limiting factors of Environment | Concept of limiting factors, laws of limiting factors – laws of minimum and tolerance, combined concept of limiting factors, Earth's carrying capacity | 8 | CO5 |
| 7 | Taxonomy | Definition of taxonomy, Systematics, and classification; morphological and taxonomical studies of flora and fauna. | 8 | CO3 |
| 8 | Microbiology | Basic concept on structures and functions of bacteria and viruses | 8 | CO5 |

1. Ecology and Environment: P.D. Sharma., Rastogi Publication.

2. Fundamental of Ecology: E. P. Odum, W. B. Saunders Company, USA

3. Ecology, 2nd Edition by Paul Colinvaux, Wiley.

4. Ecology: From Individuals to Ecosystems by Michael Begon & Colin R. Townsend & John L. Harper; Blackwell publishing.

5. Ecology: Theories and Applications (4th Edition) by Peter Stiling; Prentice Hall.

6. Textbook of Environmental Studies, Erach Bharucha, Orient longman Pvt. Ltd., Ernakulam.

e-Learning Source:

1. <https://www.doccity.com/en/environmental-science-environmental-biology-lecture-notes/233205/>

2. https://www.bdu.ac.in/cde/SLM/SLM_SAMPLE/BSc-Zoology.pdf

3. <https://www.youtube.com/watch?v=I3WLJFXSbhw>

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 | 2 | | | | |
| CO2 | 3 | 3 | | | | | | | | | | | 3 | 2 | | | | |
| CO3 | 2 | 2 | | | | | | | | | | | 2 | 2 | | | | |
| CO4 | 3 | 3 | | | | | | | | | | | 3 | 2 | | | | |
| CO5 | 2 | 2 | | | | | | | | | | | 2 | 2 | | | | |

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

Name & Sign of Program Coordinator

Sign & Seal of HoD



Integral University, Lucknow

Effective from Session: 2024-2025

| Course Code | B150202P/134 | Title of the Course | Practical on Environmental Biology | L | 0 | T | 0 | P | 4 | C | 2 |
|-------------------|--|---------------------|------------------------------------|---|---|---|---|---|---|---|---|
| Year | 1 st Year | Semester | 2 | | | | | | | | |
| Pre-Requisite | 10+2 with Science | Co-requisite | | | | | | | | | |
| Course Objectives | This course provides an introduction to the basic laboratory principles. Furthermore, students will have hands on experience and perform laboratory work in identifying and analyzing different environmental problems related with air, water pollution, and environmental degradation. | | | | | | | | | | |

Course Outcomes

| CO1 | The student will be to understand about Good Laboratory Practice (GLP). |
|-----|---|
| CO2 | Student will develop practical knowledge on Measurement of different soil parameters. |
| CO3 | Be able to Illustrate abiotic/biotic interactions and symbiotic relationships |
| CO4 | Develop knowledge on Preparation of Herbarium and its Documentation |

| 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 | 8 | CO1 |
| 2 | Soil Analysis | To Study the NPK of soil samples using soil analysis Kit. | 8 | CO2 |
| 3 | Ecosystem | Study of a simple ecosystem (Suggested habitats: pond, river, estuarine, grassland, forest and desert) and description of the biotic and abiotic components of the ecosystem | 8 | CO3 |
| 4 | Survey of Flora and Fauna | 1. Survey of vegetation in an area. 2. Survey of birds, insects and other animals in an area. 3. Preparation of Herbarium | 8 | CO4 |

Reference Books:

| |
|---|
| 1. Muller-Dombois, D. and Ellenberg, H. (1974). Aims and Methods of Vegetation Ecology, Wiley, New York. |
| 2. Odum, E.P. (1983), Basic Ecology, Sanders, Philadelphia. |
| 3. Robert Ricklefs (2001). The Ecology of Nature. Fifth Edition. W.H. Freeman and Company. |
| 4. Singh K.P. and J.S. Singh (1992). Tropical Ecosystems: Ecology and Management. Wiley Eastern Limited, Lucknow, India. |
| 5. Singh, J.S. (ed.) 1993. Restoration of Degraded Land: Concepts and Strategies. Rastogi Publications, Meerut. |
| 6. Smith, R.L. (1996). Ecology and Field Biology, Harper Collins, New York. |
| 7. Botkin, D.B. and Keller, E.A. 2000. Environment Science: Earth as a living planet. Third Edition. John Wiley and Sons Inc. |

e-Learning Source:

| |
|--|
| 1. https://www.docsity.com/en/environmental-science-environmental-biology-lecture-notes/233205/ |
| 2. https://www.bdu.ac.in/cde/SLM/SLM_SAMPLE/BSc-Zoology.pdf |
| 3. https://www.youtube.com/watch?v=I3WLJFXSbhw |

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

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: 2024-2025

| | | | | | | | |
|--------------------------|---|----------------------------|--|----------|----------|----------|----------|
| Course Code | B150203T/ES135 | Title of the Course | Eco-Restoration and Invaded Ecosystems | L | T | P | C |
| Year | 1st | Semester | II | 3 | 1 | 0 | 4 |
| Pre-Requisite | 10+2 | Co-requisite | NONE | | | | |
| Course Objectives | The aim of the course is to define the principles of ecological restoration and ecotourism and investigate the complex and dynamic interactions between humans and their environment. This advanced ecosystem management course will begin with an overview of the ecological basis for plant invasions in managed forests and terrestrial ecosystems, and then focus on methods for restoration of invaded and formerly invaded systems. Management tools and techniques for prevention, control, and restoration will be discussed, and plant invasions | | | | | | |

Course Outcomes

| | |
|------------|---|
| CO1 | Be able to interpret and critically assess theories related to restoration ecology, biotic interactions, and ecological succession |
| CO2 | Predict the issues related to the environmental ecosystem degradation and Eco restoration |
| CO3 | Understand how to use modern tools, methods, and traditional knowledge to prevent and control plant invasions and to restore formerly invaded ecosystems. |
| CO4 | Predict the issues related to the environmental ecosystem degradation and Eco restoration |
| CO5 | Develop skills and demonstrate how to integrate ecological concepts into management efforts |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|-----------------|--|---|---------------------|------------------|
| 1 | Restoration Concept | Concepts of restoration, single vs. multiple endpoints; ecosystem reconstructions; physical, chemical, biological, and biotechnological tools of restoration. Various approaches to Restoration Ecology of Disturbed Ecosystems: disturbance and its impact on the structure and functioning of terrestrial and aquatic ecosystems. | 8 | CO1 |
| 2 | Restoration of Ecosystems & Biodiversity | Ecology of Disturbed Ecosystems: disturbance and its impact on the structure and functioning of terrestrial and aquatic ecosystems. Restoration of biological diversity: Acceleration of ecological succession, reintroduction of biota. Restoration of contaminated soils and soil fertility, mine spoil restoration. Restoration in the context of Sustainability, Globalization and Sustainability | 8 | CO2 |
| 3 | Role of Local people, Organization, and collaboration | Community participation in eco-restoration traditional sacred land restoration, water restoration its techniques, practices regulation concept of traditional knowledge and transmission and maintenance of traditional knowledge on eco restoration over generations, ecosystem services and human wellbeing, NGO's, educational, research institutions and other agencies. | 8 | CO3 |
| 4 | Eco restoration Ethics | Ethics in Eco-restoration: virtue, utilitarian and deontological theories; Religion and ethics; Political ecology; Ownership and intellectual property rights; Codes of conduct. | 6 | CO3 |
| 5 | Invasion theories and mechanism | Introduction, Theories and Mechanisms for Invasion, Dispersal Mechanisms, Dispersal Mechanisms, Biotic interactions (competition, facilitation, mutualism) | 6 | CO4 |
| 6 | Ecological Impacts following Invasion and Ecosystem reclamation | Impacts to ecological processes (nutrient cycles), Impacts to ecological processes (fire and water), Impacts to plant communities (biodiversity vs saturation), Eco remediation techniques, general principles, bioremediation, phytoremediation in eco-restoration | 8 | CO4 |
| 7 | Management and Restoration of Invaded Ecosystems | Management and Restoration of Invaded Ecosystems, Techniques for control I- Integrating plant biology into control, Restoration of invaded ecosystem I- restoring plant communities, Restoration of invaded systems II- restoring ecosystem function, Restoration of invaded systems II- case studies and efficacy, Invasive species management and restoration in a changing environment | 8 | CO5 |
| 8 | Case Studies | Ecological Restoration of Lantana-Invaded. Landscapes in Corbett Tiger Reserve, Restoration of Lake Kukkarahalli in Mysore, Mangrove restoration, Land reclamation and restoration of natural ecosystem: a case study from opencast mines of northeastern Coalfields of India. | 8 | CO5 |

Reference Books:

| | |
|----|---|
| 1. | Agarwal, A. N (1980) Indian Agriculture, Vikas publishing House, New Delhi, |
| 2. | Weaver, D. B (2001) The Encyclopedia of Ecotourism, CABI, Publishing, U.K. |
| 3. | Byrne, P. 1999. The Philosophical and Theological Foundations of Ethics. 2d ed. Palgrave Macmillan, London, UK. |
| 4. | https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000014ER/P000282/M027568/ET/1519296718Paper12_EM_Module28_etext.pdf |
| 5. | Sinha, P. C (2003) Encyclopedia of Ecotourism, Vol – I, II & III, Anmol publications Pvt. Ltd, New Delhi. |
| 6. | Bhatia, A. K (1978) Tourism in India |
| 7. | Ecological Restoration, Second Edition: Principles, Values, and Structure of an Emerging Profession (Society for Ecological Restoration) Paperback – Import, 28 February 2013 by Andre F. Clewell (Author), James Aronson (Author) |
| 8. | Google book: International principles and standards for the practice of ecological restoration. Second edition George D. Gann ,Tein McDonald ,Bethanie Walder ,James Aronson ,Cara R.Nelson ,Justin Jonson ,James G. Hallett ,Cristina Eisenberg ,Manuel R. Guariguata ,Junguo Liu ,First published: 04 September 2019, https://doi.org/10.1111/rec.13035 |

e-Learning Source:

| | |
|----|--------------|
| 1. | SWAYAM |
| 2. | Virtual Labs |
| 3. | ALMS |
| 4. | MOOC |

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

| PO-PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|---------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| CO1 | 3 | 2 | 1 | 1 | 1 | 3 | 2 | | | | | | 3 | 3 | 3 | 2 | 1 | - |
| CO2 | 3 | 2 | 2 | 1 | 1 | 3 | 2 | | | | | | 3 | 3 | 3 | 2 | 1 | - |
| CO3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | | | | | | 3 | 3 | 3 | 2 | 1 | - |
| CO4 | 3 | 2 | 2 | 1 | 1 | 3 | 2 | | | | | | 3 | 3 | 3 | 2 | 2 | - |
| CO5 | 2 | 3 | 1 | 1 | 1 | 3 | 2 | | | | | | 3 | 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: 2024-2025

| | | | | | | | |
|-------------------|--|---------------------|-----------------------|---|---|---|---|
| Course Code | B150204P/E S136 | Title of the Course | Ecosystem Dynamic Lab | L | T | P | C |
| Year | I st | Semester | II | 0 | 0 | 4 | 2 |
| Pre-Requisite | 10+2 | Co-requisite | None | | | | |
| Course Objectives | This course provides knowledge about the various type of invasive species its establishment, area extent, influence of biotic and abiotic factor etc. Further, student will explore the advance tool and techniques of eco restoration of terrestrial and aquatic ecosystem. | | | | | | |

| Course Outcomes | |
|-----------------|--|
| CO1 | To identify the invasive plant species. |
| CO2 | Student will explore the landscape ecology in term of degraded area extant, population and community ecological changes. |
| CO3 | To study about the ecological succession steps. |
| CO4 | Students will explore the advance techniques for environmental monitoring. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|----------|-----------------------|---|--------------|-----------|
| 1 | Field visit | <ul style="list-style-type: none"> Explore the invasive species in the focused area | 15 | CO1 |
| 2 | Landscape Ecosystem | <ul style="list-style-type: none"> Identification of degraded areas/landscape/ecosystems Study the population and community ecology changes in the area | 15 | CO2 |
| 3 | Ecological Succession | <ul style="list-style-type: none"> Specific areas of focus include effects of abiotic and biotic disturbances on vegetation and animals. | 15 | CO3 |
| 4 | Ecosystem Disturbance | <ul style="list-style-type: none"> Identify the disturbing factors in and ecosystem viz. natural disasters, climate change, invasion, anthropogenic activities. To study about the forest fire area extent using environmental monitoring techniques namely RS and GIS, ecological methods, surveys, and ground studies | 15 | CO4 |

| Reference Books: | |
|--------------------|---|
| 1. | Gardner, R.H., Robert,V., O'Neill, T.irner,M.G. 2001. Landscape Ecology in Theory & Practice. Pattern and Process. Springer-Verlag, USA |
| 2. | Agarwal, A. N (1980) Indian Agriculture, Vikas publishing House, New Delhi, |
| 3. | Bharucha, E. 2003. Biodiversity of India. The. Mapin Publishing, India |
| 4. | Egan,D. and Howell, E.A. (eds.) 2001. The Historical EcoogyHandbook : A Restorationist's Guide to Reference Ecosystems. Island Press, Washington DC USA |
| e-Learning Source: | |
| 1. | SWAYAM |
| 2. | MOOC |
| 3. | https://www.youtube.com/watch?v=3GfoRRxpVVA |

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

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

| | |
|------------------------------------|--------------------|
| Name & Sign of Program Coordinator | Sign & Seal of HoD |
|------------------------------------|--------------------|



Integral University, Lucknow

| Effective from Session:2024-2025 | | | | | | | | | | | | | | | | | | |
|---|---|---|-----|-----|---------------------|-----|--------------------------------------|-----|-----|------|------|------|------|--------------|------------|------|------|------|
| Course Code | | B150205T/ES137 | | | Title of the Course | | Natural Resources and its Management | | | | | | L | T | P | C | | |
| Year | | 1st | | | Semester | | II | | | | | | 3 | 1 | 0 | 4 | | |
| Pre-Requisite | | Basic science | | | Co-requisite | | NIL | | | | | | | | | | | |
| Course Objectives | | To be aware about different types of resources and its distribution. To understand sustainable exploration, use and conservation of different types of resources. To approaches to natural resource management and to maintain ecological diversity | | | | | | | | | | | | | | | | |
| Course Outcomes | | | | | | | | | | | | | | | | | | |
| CO1 | Students will be able to introduced and aware from different types of resources and its distribution. | | | | | | | | | | | | | | | | | |
| CO2 | Students will be able to analyze soil resources and how soil quality get affected by different factors/events. | | | | | | | | | | | | | | | | | |
| CO3 | Understand sustainable exploration, use and conservation of different types of mineral resources. | | | | | | | | | | | | | | | | | |
| CO4 | Students will be able to know about importance of water resources, Remedial Measures in conserving water resources. | | | | | | | | | | | | | | | | | |
| CO5 | The knowledge can be apply to prevent overexploitation, long-term measures for productivity and conservation resources. | | | | | | | | | | | | | | | | | |
| Unit No. | Title of the Unit | Content of Unit | | | | | | | | | | | | Contact Hrs. | Mapped CO | | | |
| 1. | Introduction to Natural Resources | Resources and Reserves, Classification, and types of of natural resources--3 Renewable and Non-renewable resources, Major Resources of India...3 | | | | | | | | | | | | 6 | CO1 | | | |
| 2. | Soil Resources | Soil Formation and soil degradation - Soil erosion, Soil Fertility,...2 Role of organic matter and its significance in soil quality2– Diagnosis of soil nutrient deficiencies, Green manuring,...2 Animal manures and Composting -Wasteland development strategies...2 | | | | | | | | | | | | 8 | CO2 | | | |
| 3. | Mineral Resources | Origin, distribution and types of minerals ...2-Exploration of mineral resources,...2. Impact of mining activities on environment...2 - Conservation of mineral resources...2 | | | | | | | | | | | | 8 | CO3 | | | |
| 4. | Water Resources | Potential of Water resource, Causes and impact of water scarcity,...2 Integrated water resource management -Watershed management,...4 Introduction to Wetland and its conservation Ecological significance of mangroves...2 | | | | | | | | | | | | 8 | CO4 CO5 | | | |
| 5. | Forest Resources | Forest resources: Distribution, economic and ecological importance of forests,...4 Deforestation: Cause & impact. Forest management Strategies...2, Afforestation &Reforestation...2 | | | | | | | | | | | | 8 | CO5 | | | |
| 6. | Renewable energy | Current status and future prospect of Renewable energy...2, Solar Energy-Solar ,Thermal Systems...2,solar cells, Hydro-power development, potential, Wind Energy..2, Tidal Energy, Ocean Thermal Energy Conversion (OTEC), Geothermal Energy, Energy from Biomass, Bio-Diesel...2 | | | | | | | | | | | | 8 | CO1 CO5 | | | |
| 7. | Non-renewable energy | Oil-exploration, extraction and processing..2, Natural Gas: exploration, liquified petroleum gas..2, Coal: reserves, classification, extraction, processing...2, Environmental impacts of nonrenewable energy consumption....2. | | | | | | | | | | | | 8 | CO1 CO5 | | | |
| 8. | Resource Conservation | Approaches of natural resource conservation: ecological approach, economic approach...3, ethnological approach, integrated resource management strategies...3 | | | | | | | | | | | | 6 | CO5 | | | |
| Reference Books: | | | | | | | | | | | | | | | | | | |
| Craig, J.R., Vaughan. D.J. & Skinner. B. J. 1996. Resources of the Earth: Origin, use and Environmental Impacts (2nd edition). Prentice Hall, New Jersey. | | | | | | | | | | | | | | | | | | |
| Freeman, A.M. 2001 . Measures of value mid Resources. Resources for the Future. Washington DC. | | | | | | | | | | | | | | | | | | |
| Ginley, D.S. & Calien, D. 20.11.Fundamentals of Materials for Energy and Environmental . | | | | | | | | | | | | | | | | | | |
| Klee, G.A. 1991 . Conservation of Natural Resources. Prentice Hall Publication. | | | | | | | | | | | | | | | | | | |
| Dutta A (2001) Biodiversity and ecosystem Conservation. Kalyani Publisher, Kolkata. | | | | | | | | | | | | | | | | | | |
| Jha LK (1997) Natural Resource Management. APH Publishing Corporation, New Delhi. | | | | | | | | | | | | | | | | | | |
| Kumar HD (1995) Modern Concepts of Ecology. Vikas Publishing House (P) Ltd., New Delhi. | | | | | | | | | | | | | | | | | | |
| MaDicken KG and Vergora NT (1990) Agroforestry: Classification & Management. John Wiley & Sons, New York. | | | | | | | | | | | | | | | | | | |
| e-Learning Source: | | | | | | | | | | | | | | | | | | |
| Nalini KS (1993) Environmental Resources and Management, Anmol Publications (P) Ltd., New Delhi. | | | | | | | | | | | | | | | | | | |
| Nautiyal S and Kaul AK (1999) Forest Biodiversity & its Conservation Practices in India. | | | | | | | | | | | | | | | | | | |
| http://web.worldbank.org/archive/website00675/WEB/PDF/ENVST-18.PDF | | | | | | | | | | | | | | | | | | |
| https://www.researchgate.net/publication/294369522_Integrated_Soil_and_Water_Resource_Management_for_Livelihood_and_Environmental_Security | | | | | | | | | | | | | | | | | | |
| https://www.isric.org/utilise/global-issues/water | | | | | | | | | | | | | | | | | | |
| https://www.mdpi.com/journal/resources/special_issues/Mineral_Resource_Assessment_Mining_Processing | | | | | | | | | | | | | | | | | | |
| 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 | - |

Department of Environmental Science

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: 2024-2024

| | | | | | | | |
|----------------------|----------------|----------------------------|-----------------------|----------|----------|----------|----------|
| Course Code: | B150206P/ES138 | Title of the Course | Natural Resources Lab | L | T | P | C |
| Year | 1st | Semester | II | 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 Natural Resource To understand estimation of particle size distribution of the soil. To know how to determine the specific gravity and moisture content of the soil. | | | | | | |
|--------------------------|--|--|--|--|--|--|--|

| | | | | | | | |
|------------------------|--|--|--|--|--|--|--|
| Course Outcomes | | | | | | | |
| CO1 | Able to explain and conduct natural resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goal | | | | | | |
| CO2 | Gain practical knowledge about productivity and usage of forest resource. | | | | | | |
| CO3 | Gain knowledge on analysis and interpretation of different physical properties of soil. | | | | | | |
| CO4 | Able to monitor impact of developmental activities on natural resources | | | | | | |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|-----------------|--------------------------|--|---------------------|------------------|
| 1 | Field Visit | Visit to different reservoir of Natural Resource (River, Forest, mines etc.) field report submission based on the survey of local sites. | 15 | CO1 |
| 2 | Study of Forest | Estimation of Forest Canopy Cover, Forest produce, Deforestation pattern | 15 | CO2 |
| 3 | Soil & Mineral analysis | To diagnose Soil nutrient deficiency, Soil Horizon Measurements To study pore space, water holding capacity and bulk density of soil. | 15 | CO3 |
| 4 | Environmental Monitoring | Environmental Impact Assessment of Hydro project/Mining sites Prepare a working model on Solar light, Rainwater harvesting system, Soil Profile | 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 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | 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 |

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 | I150208T /ES140 | Title of the Course | Ecotourism & Wildlife Management | L | T | P | C |
|-------------------|--|---------------------|----------------------------------|---|---|---|---|
| Year | 1st | Semester | II | 2 | 1 | 0 | 3 |
| Pre-Requisite | Natural Resource | Co-requisite | NIL | | | | |
| Course Objectives | To provide basic knowledge of Eco-Tourism. To provide knowledge of methods and data used for Interesting Eco-tourism. To provide knowledge of Impact of Eco-tourism. To provide knowledge of the concept of bioassay. To develop knowledge of Wildlife management. | | | | | | |

Course Outcomes

| | |
|------------|--|
| CO1 | Have an enhanced knowledge of Eco-tourism. |
| CO2 | Be able to make connection and interrelations between data used for Interesting Eco-tourism. |
| CO3 | Be able to explain Impact of Eco-tourism and their environment. |
| CO4 | Be able to explain Wildlife Conservation and related problems. |
| CO5 | Be able to describe Wildlife Management. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|----------|---|---|--------------|-----------|
| 1 | Introduction to Eco-Tourism | Ecotourism – study history of tourism; identify various forms of tourism and evolution of ecotourism. Dimensions of tourism and essential conditions for tourism to occur. Differences between tourism components. Mass tourism versus ecotourism. Consumptive and Non-Consumptive Tourism. | 08 | 1 |
| 2 | Interesting Eco-tourism | - Places of interests of Ecotourism in India. Ecotourism in practice in important PA's of India- case studies of Periyar Tiger Reserve, Keoladeo National Park, Kanha National Park and Jim Corbet National Park. Important Biosphere Reserves as ecological centre. | 08 | 2 |
| 3 | Ecosystems study | Study of different Ecosystems – Rain forest Ecotourism – Mountain Ecotourism – Polar, Islands and Coasts Ecotourism – Wilderness - Marine Ecosystem. | 06 | 2 |
| 4 | Impact of Eco-tourism | Impact of Ecotourism, Types and Degree of Impacts from Ecotourism activities– Ecotourism related organization. Positive and negative impact of Ecotourism, Responsible ecotourism, Impact of eco-tourism on Economy. | 08 | 3 |
| 5 | Wildlife Conservation | Wildlife conservation - Protected Areas Network in India - Goals of management, Strategies for planning. | 08 | 4 |
| 6 | Factors influencing wildlife management | Factors influencing wildlife management such as habitats, population, behaviour, food- habits health etc. Tools for data collection and analysis. | 06 | 4 |
| 7 | Wildlife Management | Wildlife Management process, elements of wildlife management in India. Role of local communities in Wildlife management. | 08 | 5 |
| 8 | Wildlife conflicts | Man-wildlife conflicts – Poaching of wildlife – Wild life conservation laws – The Wildlife (Protection) Act, 1972 (2002 amendment). | 08 | 5 |

Reference Books:

- 1-Dasma RF (1968) Environmental Conservation Joh Wiley and Sons New York.
- 2-Mukherje N (2008) Ecotourism and sustainable Development. Cybetechn Publications, New Delhi.
- 3-Prabha Chandra (2003) Global Ecotourism Kaniskha Publishers, New Delhi.
- 4-Sinha P.C (2003) Encyclopedia of Ecotourism, Volume I, II and III, Anmol Publication Pvt. Ltd., New Delhi.
- 5-Weaver DB (2001) The Encyclopedia of Ecotourism, CABI Publishing, UK.

e-Learning Source:

- <https://www.slideshare.net/chandikeehelamalpe/ecotourism-64745161>
<https://www.slideshare.net/ravindradas5/eco-tourism-42047943>
<https://www.slideshare.net/AndrewMyrthong/ecotourism-57238509>
<https://slideplayer.com/slide/6063870/>
<https://www.slideshare.net/apoorvkumar9277/wildlife-conservation-37245301>
<https://www.google.com/search?client=firefox-b-d&q=Wildlife+Management+ppt>

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

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

| | |
|---|-------------------------------|
| Name & Sign of Program Coordinator | Sign & Seal of HoD |
|---|-------------------------------|