Integral University, Lucknow

Effective from Session: 2024-2025							
Course Code	**B150201T/ES133**	**Title of the Course**	**Environmental Biology**	**L**	**T**	**P**	**C**
Year	**First**	**Semester**	II	**4**	**0**	**2**	**6**
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, Natality, 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. Sauders 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.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	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**	**T**	**P**	**C**
Year	**1st Year**	**Semester**	II	**4**	**0**	**2**	**6**
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-Dombols, 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. ThirdEdition. 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: 2022-2023							
Course Code	B150203T/ES135	**Title of the Course**	Eco-Restoration and Invaded Ecosystems	**L**	**T**	**P**	**C**
Year	**1st**	**Semester**	II	**4**	**0**	**2**	**6**
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 CO	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/ES136	**Title of the Course**	Ecosystem Dynamic Lab	**L**	**T**	**P**	**C**
Year	**Ist**	**Semester**	II	**0**	**0**	**4**	**6**
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**	• Explore the invasive species in the focused area	15	CO1
2	**Landscape Ecosystem**	• Identification of degraded areas/landscape/ecosystems • Study the population and community ecology changes in the area	15	CO2
3	**Ecological Succession**	• Specific areas of focus include effects of abiotic and biotic disturbances on vegetation and animals.	15	CO3
4	**Ecosystem Disturbance**	• 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
Department of Environmental Science

Effective from Session:							
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- Renewable and Non-renewable resources, Major Resources of India	6	CO1
2.	Soil Resources	Soil Formation and soil degradation - Soil erosion, Soil Fertility, Role of organic matter and its significance in soil quality – Diagnosis of soil nutrient deficiencies, Green manuring, Animal manures and Composting -Wasteland development strategies.	8	CO2
3.	Mineral Resources	Origin, distribution and types of minerals -Exploration of mineral resources, Impact of mining activities on environment - Conservation of mineral resources.	8	CO3
4.	Water Resources	Potential of Water resource, Causes and impact of water scarcity, Integrated water resource management -Watershed management, Introduction to Wetland and its conservation Ecological significance of mangroves	8	CO4 CO5
5.	Forest Resources	Forest resources: Distribution, economic and ecological importance of forests, Deforestation: Cause & impact. Forest management Strategies, Afforestation &Reforestation	8	CO5
6.	Renewable energy	Current status and future prospect of Renewable energy, Solar Energy-Solar Thermal Systems, solar cells, Hydro-power development, potential, Wind Energy, Tidal Energy, Ocean Thermal Energy Conversion (OTEC), Geothermal Energy, Energy from Biomass, Bio-Diesel.	8	CO1 CO5
7.	Non-renewable energy	Oil-exploration, extraction and processing, Natural Gas: exploration, liquified petroleum gas, Coal: reserves, classification, extraction, processing, Environmental impacts of nonrenewable energy consumption.	8	CO1 CO5
8.	Resource Conservation	Approaches of natural resource conservation: ecological approach, economic approach, ethnological approach, integrated resource management strategies	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/utilisc/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	-

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:	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 CO	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

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: 2024-2025							
Course Code	**I150208T /ES140**	**Title o f 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 o f 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 a nd Sons New York.
2-Mukherje N (2008) Ecotourism and s ustainable Development. Cybetech Publications, New Delhi.
3-Prabha Chandra (2003) Global Ecotourism Kaniskha Publishers, New Delhi.
4-Sinha P.C (2003) Encyclopedia of Ecotourism, Volume I, II a n d 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/ravindraprasad5/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	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**

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2024-2025							
Course Code	B150207T/ ES139	**Title of the Course**	AI for Earth and Environmental Sciences	**L**	**T**	**P**	**C**
Year	**1st**	**Semester**	II	**4**	**0**	**0**	**0**
Pre-Requisite	10+2	**Co-requisite**	None				
Course Objectives	The curriculum aims to provide environmental sciences students with the knowledge and skills to leverage artificial intelligence for advanced research, monitoring, and sustainable management of environmental resources. It's designed to address the growing demand for individuals with an understanding of both our changing climate and artificial intelligence, together with the business acumen to deploy that understanding effectively.						

Course Outcomes	
CO1	Able to define AI and machine learning
CO2	Describe and apply AI methods covered in the course, including the basic concepts and the key algorithms
CO3	Describe pressing societal and environmental challenges, where AI has been successfully deployed to tackle them
CO4	Model societal challenges as mathematical problems that AI techniques can be applied to and recognize which AI techniques fit the problems
CO5	Gain insight into different application areas for AI and their different challenges

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Artificial Intelligence	History and evolution of AI, comparison of human and computer skills, Component of AI, Scope and significance in different domains, Ethical considerations in AI development and deployment, Intelligent Agent, logical agent. Problem-solving through AI: Defining the problem as a state space search, analyzing the problem, solving the problem by searching, informed search, and Uninformed Search	6	CO1 &2
2	Machine Learning Basics	Neural networks and deep learning, Supervised and unsupervised learning, Feature selection and engineering, learning from observation, and knowledge in learning. Natural Language Processing: Brief history of NLP, Text processing, Sentiment analysis, language translation, Early NLP system, ELIZA system, LUNAR system, General NLP system.	6	CO2 & CO5
3	Applications of AI & ML	Healthcare, Transport, Banking and finance, Security, Education, Robotics, Agriculture, E-commerce, poverty, homelessness, and social media, Using AI 'guardians' to save trees, reduce the carbon footprint of steel and energy waste reduction, Tackle poaching, smart agriculture, plotting clouds using computers, environmental sustainability (biodiversity, climate, water, forests), disasters, and climate change.	16	CO2 & 3
4	Models development with AI	Developing models/determining important variables within models for the studies of climate, biology, geography, genetics, and many other fields relevant in the Earth and Environmental Sciences. Python tutorials and individual Python assignments using real datasets for hands-on practice of the concepts and algorithms. AI project in the context of a societal or environmental domain.	17	CO 2,3,4 &5

Reference Books:

Pattern Recognition and Machine Learning, Christopher Bishop, Springer; 2006

An Introduction to Statistical Learning with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, Springer, 2013.

Deep Learning, Goodfellow, I., Bengio, Y. and Courville A., 2016.

Applied Mathematical Programming. Bradley, Hax, and Magnanti (Addison-Wesley, 1977).

e-Learning Source:

http://faculty.marshall.usc.edu/garethjames/ ISL/ISLR%20Seventh%20Printing.pdf

http://web.mit.edu/15.053/www/AMP.htm

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**