



Integral University, Lucknow
Department of Environmental Science

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

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

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

Reference Books:

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

e-Learning Source:

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

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

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

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

Effective from Session: 2023-2024							
Course Code:	B150302P/ES219	Title of the Course	Practical on Understanding Biodiversity	L	T	P	C
Year	2nd	Semester	III	0	0	4	2
Pre-Requisite	10+2	Co-requisite	NIL				
Course Objectives	This course provides students the knowledge and understanding of lab related to Biodiversity						
Course Outcomes							
CO1	Learn to prepare the field report and herbarium sheet.						
CO2	Practical skills about analyses of primary productivity by light and dark bottle method.						
CO3	Practical skill about the analyses of number of species in a given area and chlorophyll content of plant.						
CO4	Gain knowledge on analysis and interpretation of different physical properties of soil.						
Unit No.	Title of the Unit	Content of Unit			Contact Hrs.	Mapped CO	
1	Field Visit	Field study on ecology and biodiversity of flora and fauna of a local area/ex-situ conservation site and field report submission. Preparation of field report based on the survey of local flora (herbarium sheet).			15	CO1	
2	Ecosystem Productivity	To determine the primary productivity by light and dark bottle method. Measure the rate of respiration in an aquatic environment using dissolve oxygen probe.			15	CO2	
3	Study of Species	To find out the reproductive capacity of species. To determine the minimum size of quadrat by Species area curve method. To determine the density/ abundance of various species occurring in a given area. To study the species richness in a given area. To determine chlorophyll content of the given plant material.			15	CO3	
4	Soil Analysis	To study pore space, water holding capacity and bulk density of soil. Qualitative analysis of soil organic carbon, Soil PH. To study the texture of soil depending upon the particle size.			15	CO4	
Reference Books:							
1. Anne E. Magurran, Brian J. McGill (2011) Biological Diversity: Frontiers in Measurement and Assessment. Oxford University Press. ISBN: 978-0199580675.							
2. Loreau, M. & Inchausti, P. 2002. Biodiversity and Ecosystem functioning: Synthesis and Perspectives. Oxford University Press, Oxford, UK							
3. Pandey, P.N. (2017). Biodiversity Environmental Science Forestry, Narendra Publication house.							
4. Rao K.S, K.S. Rao (1993). Practical Ecology. Anmol Publication, 190 pages							
5. Singh, J. S. & Singh, S. P. 1987. Forest vegetation of the Himalaya. The Botanical Review 53:80-192.							
6. Dane, J.H. & Topp, G.C. (2004). (eds) Methods of Soil Analysis: Part 4, Physical Methods. SSSA							
7. Kaushik, Anubha and Kaushik, C.P. (2018) Perspectives in Environmental Studies.							
e-Learning Source:							
1. Study of soil pH, https://youtu.be/ViWCoeFwH9M .							
2. Preparation of herbarium sheets, https://youtu.be/CK4vepuWzrM							
3. Herbarium - CSIR-NBRI, https://youtu.be/6tJdvDzPzR8 .							
4. Primary productivity, https://youtu.be/9LpMskfUgz0 .							
5. Light-Dark bottle method, https://youtu.be/i5Tit4BgfIE .							
6. AMRITA, OLABS, Study of Physical Properties of Soil. http://amrita.olabs.edu.in/?sub=79&brch=18&sim=235&cnt=1							

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

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

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

Effective from Session:2023-24																		
Course Code	B150303T/ES220			Title of the Course	Human-Wildlife Conflict & Management					L	3	T	1	P	0	C	4	
Year	2nd			Semester	III													
Pre-Requisite	10+2			Co-requisite	Nil													
Course Objectives	Provide general introduction about wildlife management, To study Role of government in wildlife conservation and management. The evolution of wildlife conservation and policies regarding protected areas in 21th century. To study different types of Environmental Act. for wildlife conservation. Importance of forest produce to tribal population and tribal right in India. Impact of human wildlife conflict in environment.																	
Course Outcomes																		
CO1	To Provided knowledge of government in Biodiversity conservation.																	
CO2	Be able to explain protected areas and Evolution of wildlife conservation.																	
CO3	To create knowledge Environmental Act. for wildlife conservation.																	
CO4	To provided knowledge tribal population and tribal right in India.																	
CO5	To provided knowledge of human wildlife conflict.																	
Unit No.	Title of the Unit	Content of Unit											Contact Hrs.	Mapped CO				
1	Introduction to wildlife management	Need of Wildlife management; Reasons of Man-wildlife conflict, Importance of Wild life conservation, Role of government, biologists and social scientists in Wildlife management.											06	CO1				
2	Protected area and types	Protected area: Types of protected areas, Wildlife Sanctuaries, National Parks, Biosphere Reserves. IUCN categories. Concept of deep and Shallow ecology.											06	CO1				
3	Evolution of wildlife management	Journey of mankind from predator to conservator. Prehistoric association between wildlife and humans: records from Bhimbetkawall paintings. Conservation of wildlife in the reign of king Ashoka: excerpts from rock edicts, Bishnoi community. Understanding wildlife management, conservation and policies regarding protected areas in 21st century.											08	CO2				
4	Wildlife conservation policies in India	National policy governing wildlife protection in India, Historical perspective evolution of policies during different eras. Current policy, National Wildlife action plan and its detailed review. Concept of core and buffer area in a protected range.											08	CO3				
5	Wildlife conservation Asin India	Brief introduction to Wildlife Protection Act of 1972, Forest Act 1927, Environmental Protection Act 1986, and Forest conservation Act 1980. Introduction of Tiger task force and National Tiger Conservation Authority.											08	CO3				
6	Legal basis of wildlife conflicts	Impact of conflict on humans and wildlife, impact of habitat fragmentation, social inequality in terms of forest conservation. The nature and extent of legal and illegal trade in wildlife species. Illegal wildlife trade in India and different parts of the world. Major trade routes and trade centers with reference to India.											08	CO4				
7	Introduction to tribal rights	Introduction to tribal rights in India. Importance of forest produce to tribal populations. Scheduled tribes and other traditional Forest dwellers (Recognition of forest right) Act, 2006.											08	CO4				
8	Wildlife Conflicts	Insight into the important conflicts: Keoladeo National Park conflict of Bharatpur, Human and Elephant conflicts of Kerala and West Bengal, Fisherman and tiger conflict of Sundarbans Forest, Shifting cultivation in North east India.											08	CO5				
Reference Books:																		
1-Conover, M. 2001. Resolving Human Wildlife Conflicts, CRC Press.																		
2-Dickman, A. J.2010.Complexities of conflict: the importance of considering social factors for effectively resolving human-wildlife conflict. Animal Conservation 13: 458-466.																		
3-Messmer, T. A. 2000. The emergence of human-wildlife conflict management: Turning challenges into opportunities. International Bio deterioration & Biodegradation45:97-102.																		
4-Paty, C. 2007. Forest Government and Tribe. Concept Publishing Company.																		
5-Treves, A. & Karanth, K. U. 2003. Human--carnivore conflict and perspectives on carnivore management worldwide. Conservation Biology17: 1491- 1499																		
6-Woodroffe, R. 2005. People and Wildlife: Conflict and Coexistence. Cambridge.																		
Woodroffe, R., Thirgood, S., & Rabinowitz, A. 2005. People and Wildlife, Conflict or Coexistence? (No. 9). Cambridge University Press																		
e-Learning Source:																		
https://www.slideshare.net/sajjadmughal3344/human-wildlife-conflict-75556196																		
https://www.slideshare.net/kpkc1633/human-wildlife-conflict-in-banke-national-parknepal																		
https://www.slideshare.net/SAISIKANPATRA/human-wildlife-conflict-155300729																		
https://slideplayer.com/slide/4897971/																		
https://www.slideshare.net/subinkmohan/strategies-adopted-to-mitigate-humanelephant-conflict-hec-in-and-around-kerala-																		
https://www.slideshare.net/rajatrmr/wildlife-presentation-87241681forest																		
Course Articulation Matrix: (Mapping of CO with PO and PSOs)																		
PO-PSO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	1	2	1	1	3	2						3	3	2	2	3	
CO2	3	1	2	1	1	3	2						3	3	3	2	2	
CO3	3	1	2	1	1	3	2						3	3	2	2	2	
CO4	3	1	3	1	1	3	2						3	3	2	2	2	
CO5	3	1	3	1	1	3	2	-	-	-	-	-	3	3	3	3	2	-

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

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

Effective from Session: 2023-2024							
Course Code	B150304P/ ES221	Title of the Course	Wildlife Management Lab	L	T	P	C
Year	2nd	Semester	III	0	0	4	2
Pre-Requisite	10+2	Co-requisite					
Course Objectives	This course provides the concepts, essential elements and skills related to wildlife conservation and management. Additionally, the concept of agroforestry and its establishment. Furthermore, ecosystem studies explore the differences, in between interlink and its structure, functioning aspects.						
Course Outcomes							
CO1	Student will explore the Sanctuaries / National Park and understand about wildlife.						
CO2	Case study of threats to wetlands						
CO3	The student will be to understand the principle and component of Agroforestry.						
CO4	Student will learn about abiotic and biotic component of terrestrial ecosystem.						
Unit No.	Title of the Unit	Content of Unit				Contact Hrs.	Mapped CO
1	Wild life field Visit	Visit to Wild life Sanctuary/National Park.				15	CO1
2	Visit to wetlands	Visit and documentation of threats to wetlands				15	CO2
3	Agroforestry concept/system	To study about the component of Agroforestry system.				15	CO3
4	Ecosystem Studies	To study Forest ecosystem.				15	CO4
Reference Books:							
1. B. B. Hosetti, M. Venkateshwarlu Wildlife Management and Conservation: Contemporary Principles and Practice							
2. S K Gupta Textbook of Wildlife Management 3rd Edition 2020							
3. Rangarajan M. (2001) India's Wildlife History, Permanent Black, New Delhi, India.							
e-Learning Source:							
1. https://drive.google.com/file/d/1izgQNDS-djRymkXZ9DLvP7N4wQGwOP1i/view							
2. https://www.cifor-icraf.org/publications/pdf/books/Agroforestry-primer-02.pdf							
3. https://www.rlbcu.ac.in/pdf/Forestry/FWM-136%20%20Wildlife%20biology.pdf							

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

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

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

Effective from Session: 2023-2024							
Course Code	B150305T/ ES222	Title of the Course	Fundamentals of Remote Sensing, Geographic Information System	L	T	P	C
Year	2nd	Semester	III	3	1	0	4
Pre-Requisite	10+2	Co-requisite	NIL				
Course Objectives	<ul style="list-style-type: none"> To study remote sensing, GIS techniques and its component and different types of platforms. Measurement of EMR interaction with environment by satellite, sensors and aerial photography. Geographical analysis by Raster and Vector data set. Statistical analysis of geographical data structure. To monitoring natural resource, forest diversity and urban sprawl analysis by Remote Sensing and GIS Technology. 						
Course Outcomes							
CO1	To develop basic knowledge of remote sensing and GIS.						
CO2	To provide knowledge of monitoring biodiversity by satellite, sensors and aerial photography.						
CO3	To provide knowledge of Geographical analysis by Raster and vector data.						
CO4	To create knowledge of Statistically analysis of geographical data structure.						
CO5	Be able to describe applications of Remote Sensing and GIS Technology.						
Unit No.	Title of the Unit	Content of Unit			Contact Hrs.	Mapped CO	
1	Introduction to RemoteSensing and GIS	Remote Sensing and GIS: Definition and Components, Development, Platforms and types.			8	CO1	
2	Photogrammetry	Aerial Photography and Satellite Remote Sensing: Principles, Types and Geometry of Aerial Photograph; Principles of Remote Sensing, EMR Interaction with Atmosphere and Earth Surface; Satellites (Landsatand IRS) and Sensors.			8	CO2	
3	Digital Cartography	Topographic sheets and its numbering system, Datum, Map Scale, Time, Latitude, Longitude, Map projections etc.			6	CO3	
4	Digital Image Processing (DIP)	Image Processing (Digital and Manual) and Data Analysis: Pre-processing (Radiometric Correction), Enhancement (Filtering); Classification (Supervised and Un-supervised), Geo-Referencing;Editing and Output; Overlays.			8	CO3	
5	Geographical Information System (GIS)	GIS Data Structures: Types (spatial and Non-spatial), Raster and Vector Data Structure. Overview of GIS software packages; GPS survey, data import, processing, and mapping.			6	CO4	
6	Basic elements of statistical analyses	Mean, Median, Mode; Standard Deviation (SD); Types of sampling distribution – normal, binomial, Poisson; measurements of central tendency and dispersion			8	CO4	
7	Application of RemoteSensing and GIS	Land use/ Land Cover, Urban SprawlAnalysis; Soil, Water resource management, Forest resources, Agriculture, Disaster Relief Management			8	CO5	
8	Case studies	Case studies of Remote Sensing and GIS, Free open data sources: USGS, BHUVAN, WRIS, NOAA			8	CO5	
Reference Books:							
1) Campbell J. B., 2007: Introduction to Remote Sensing, Guildford Press.							
2) Lillesand T. M., Kiefer R. W. and Chipman J. W., 2004: Remote Sensing and Image Interpretation, Wiley. (Wiley Student Edition).							
3) Joseph, G. 2005: Fundamentals of Remote Sensing, United Press India.							
4) Wolf P. R. and Dewitt B. A., 2000: Elements of Photogrammetry: With Applications in GIS, McGraw-Hill.							
5) Chauniyal, D.D. (2010) Sudur Samvedan evam Bhogolik Suchana Pranali, Sharda Pustak Bhawan, Allahabad							
6) Chang T.K. (2002). Geographical Information System.Tata MacGraw-Hill.							
e-Learning Source:							
https://www.nrsc.gov.in							
https://www.iirsisro.gov.in							
https://www.youtube.com/watch?v=3fbEVytyJcK							

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

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

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

Effective from Session: 2023-2024																		
Course Code	B150306P/ES223	Title of the Course		Geographical Information System Lab				L	T	P	C							
Year	2nd	Semester		III				0	0	4	2							
Pre-Requisite	10+2	Co-requisite		Nil														
Course Objectives	This course provides the basic step, types and elements of image interpretation. Student will also learn the GIS software, demonstration of the GPS and Free open data source link.																	
Course Outcomes																		
CO1	To understand the topographic map numbering system, how to download datasets.																	
CO2	Student will be able to prepare maps using digital software Arc GIS.																	
CO3	Student will explore the GPS navigation device.																	
CO4	Student will explore the free access website for satellites imagery																	
Unit No.	Title of the Unit	Content of Unit										Contact Hrs.	Mapped CO					
1	GIS Tool	Study of SOI topographic sheet, Georeferencing										15	CO1					
2	Data Analysis	Vector and Raster Image analysis										15	CO2					
3	Navigation System	Handling of GPS, data collection and integration of GPS data										15	CO3					
4	Open-source web link	Earth resource satellites; Landsat, SRTM, CARTOSAT, TRMM, MODIS, NOAA										15	CO4					
Reference Books:																		
1. Fundamentals of Geographic Information Systems, Michael N. Demers: John Wiley and Sons, Inc																		
2. Lillesand, T.M., and Kieffer, R.M., 1987: Remote Sensing and Image Interpretation, John Wiley.																		
3. Chang.T.K. 2002: Geographic Information Systems. Tata McGrawHill																		
4. Skidmore A.2002: Environmental Modeling with GIS and Remote Sensing. Taylor and Francis.																		
e-Learning Source:																		
1. http://www.nrsc.gov.in																		
2. https://youtu.be/-2B6kjtdfuE																		
Course Articulation Matrix: (Mapping of COs with POs and PSOs)																		
PO-PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO																		
CO1	2	2	2	1	1	3	3	-	-	-	-	-	3	2	3	1	3	-
CO2	3	3	2	1	1	3	3	-	-	-	-	-	3	3	3	1	3	-
CO3	3	3	3	1	1	2	2	-	-	-	-	-	2	3	3	2	3	-
CO4	2	2	1	1	1	3	3	-	-	-	-	-	3	3	3	3	3	-

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

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

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

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

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

Reference Books:

- 1- Bhattacharya, R.N. 2001. An Economic perspective, Oxford University Press.
- 2- Environmental Economics and Sustainability, Jose G Varghas- Hernandez, Monowar Alam Khalid. Pawan Kumar Bharti, 2018. Discovery Publishing House Pvt. Ltd ISBN 978-93-86841-37-7 Pg 202.
- 3- Hanley, Nick and Roberts C.J. 2002, Issues in Environmental Economics, Black well Publishers, U. K
- 4- Ward F. A. 2006, Environmental and Natural Resource Economics, Pearson Prentice Hall, New Jersey.

e-Learning Source:

- 1- https://www.soas.ac.uk/cedep-demos/000_P570_IIEP_K3736-Demo/module/pdfs/p570_unit_01.pdf
- 2- https://www.sfu.ca/~wainwrig/Econ400/documents/Econ_460_Lecture-Notes-part_One-10-3.pdf
- 3- <https://ocw.mit.edu/courses/economics/14-42-environmental-policy-and-economics-spring-2011/lecture-notes/>
- 4- <https://nptel.ac.in/courses/109107171/>

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

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

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

Effective from Session:							
Course Code	I150308T/ES226	Title of the Course	Environment and Sustainability	L	T	P	C
Year	2nd	Semester	III	2	1	0	3
Pre-Requisite	10+2	Co-requisite	Basic knowledge of environment				
Course Objectives	A sustainable human society is one that satisfies its needs without jeopardizing the opportunity of future generations to satisfy theirs. The challenge of how we achieve a sustainable society is a vital theme that unites the various disciplines within environmental studies. This course is designed to help the students to bridge the scientific approach to analyzing and solving environmental problems with the socioeconomic concerns involved in formulating and administering environmental policy and the historic and philosophical basis of humanity's relationship to ecosystems. With the common goal of defining and understanding environmental sustainability, the course identifies how each participating discipline can creatively contribute towards this end.						
Course Outcomes							
CO1	Understand the basic concept of Sustainable Development (SD), the environmental, social and economic dimensions.						
CO2	In depth learning and analysis of factors that support to achieve sustainability and resilience in an individual level and in a community						
CO3	Develop an encompassing understanding of sustainability issues.						
CO4	Understand the embedment of sustainability issues in environmental, societal, and economic systems, and the relevance of the conditions, interrelations, and dynamics of these systems.						
CO5	Demonstrate knowledge and understanding of the current sustainable development policies followed by selected countries						
Unit No.	Title of the Unit	Content of Unit				Contact Hrs.	Mapped CO
1	Introduction to Sustainable Development	Broad introduction to SD - its importance, need, impact and implications; definition coined; evolution of SD perspectives (MDGs AND SDGs) over the years; recent debates; 1987 Brundtland Commission and outcome; later UN summits (Rio summit, etc.) and outcome.				8	CO1 & 2
2	Dimensions to Sustainable Development	Society, environment, culture and economy; current challenges - natural, political, socio-economic imbalance; sustainable development initiatives and policies of various countries: global, regional, national, local; needs of present and future generation - political, economic, environmental.				8	CO, 2& CO5
3	Gauging Sustainable Development	Sustainability and development indicators and SDGs, UN's outlook of sustainable development and efforts, UN SDGs - structure, governance and partnerships; communities / society: ensuring resilience and primary needs in society; biosphere: development within planetary boundaries; strengthening institutions for sustainability; shaping a sustainable economy.				10	CO2, 3 & 5
4	Challenges for SD	Climate change, resource depletion, food-energy-water nexus, eutrophication, acidification, human/ecosystem toxicity, smog, ozone depletion. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.				10	CO 2,3,4 & 5
5	Sustainability Practices	Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles, carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socioeconomic and technological change.				12	CO4 & CO5
6	Activities	Plantation, best out of waste, Determine Your Carbon Footprint, Visit the Local Recycling Centre, Composting, Plastic Pollution strategy, Save Energy, Inspire Sustainable Attitudes				12	CO1, 2,3,4 & 5
Reference Books:							
Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.							
Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.							
Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.							
Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.							
Bradley, A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.							
Environment Impact Assessment Guidelines, Notification of Government of India, 2006.							
Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.							
e-Learning Source:							
SWAYAM, MOOC, e-Skill India, Coursera, Udemy, National Digital Library of India							

Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO													
CO1		2			2		3				3		2
CO2	3		2					2	3	2		2	
CO3	2				2			2					2
CO4			3			2		2			2	3	
CO5	3				3	2					3		3

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

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

Effective from Session: 2023-2024							
Course Code	B150401T/ES227	Title of the Course	Environmental Pollution & Management	L	T	P	C
Year	2nd	Semester	IV	3	1	0	4
Pre-Requisite	10+2	Co-requisite					

Course Objectives	<p>1. It will enable students to understand environmental problems, looking at causal linkages between pollution sources, exposure pathways and impacts to environmental quality and human health.</p> <p>2. Students will identify the complex relationships between environmental factors and human health, taking into account multiple pathways and interactions, will be assessed in a broader spatial, socioeconomic and cultural context.</p> <p>3. Students will learn how to assess pollution sources, study exposure pathways and fate, and evaluate consequences of human exposure to pollution and its impacts to environmental quality.</p> <p>4. Providing the evidence base to support decision and policy making, students should be able to understand pollution problems, consider ways to respond to them, and propose appropriate solutions/actions to reduce (protect, mitigate or prevent) pollution risks when necessary</p>
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Course Outcomes

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

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

Reference Books:

- 1.Khopkar SM (1993) Environmental Pollution Analysis
- 2.Saxena HM (2011) Environmental Geography
3. Rao CS (1993) Environmental Pollution Control

e-Learning Source:

- 1-<https://www.frontiersin.org/articles/10.3389/fpubh.2020.00014/full>
- 2-<https://www.hindawi.com/journals/jeph/2012/341637/>
- 3-<https://www.epa.gov/air-quality-management-process/managing-air-quality-human-health-environmental-and-economic>

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

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

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

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

Course Outcomes

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

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

Reference Books:

- AMRITA, OLABS, Study of pollutants in Air.
- AMRITA, OLABS, Studies on Turbidity, pH and Microbial Presence in Water.

e-Learning Source:

- <http://amrita.olabs.edu.in/?sub=79&brch=18&sim=240&cnt=1>.
- <http://amrita.olabs.edu.in/?sub=79&brch=18&sim=229&cnt=1>.
- PM - Particulate Matter, <https://youtu.be/ZUsNCq8acYM>.
- Monitoring methods for Air – PM, <https://youtu.be/-uZURNKE4z8>.
- Noise pollution measurement by sound level meter, <https://youtu.be/j4sq4CmGV5o>.

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

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO6	PSO7
	CO															
CO1	2	1	1	1							2	2	2	2		
CO2	2	1	1	1							2	2	2	2		
CO3	2	1	1	1							2	2	2	2		
CO4	2	1	1	1							2	2	2	2		
CO5																

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

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

Effective from Session: 2023-2024

Course Code	B150403T/ES229	Title of the Course	Basics of Environmental Methods and Analytical Techniques	L	T	P	C
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Year	II	Semester	IV	3	1	0	4	
Pre-Requisite	10+2	Co-requisite						
Course Objectives	This subject enables the students to learn the different parameters of Environmental methods for analysis							
Course Outcomes								
CO1	Student gain an insight about different aspects of analytical environmental methods and soil analysis							
CO2	Demonstrate extensive knowledge of the ecological instrumentation and spectrophotometry							
CO3	Students can describe the most common methods of electrophoresis and instrumental analysis							
CO4	Students will be able to explain the general parameters of water analysis							
CO5	Students will be able to explain different air sampling equipments							
Unit No.	Title of the Unit	Content of Unit					Contact Hrs.	Mapped CO
1	Introduction	Soil collection and preservation, Significance, Importance of Water, soil and air analysis					8	CO1
2	Soil Analysis	Analysis of particle size, water holding capacity, temperature, pH, conductivity, exchangeable calcium and Magnesium, sodium and potassium, available phosphorus, nitrogen, alkalinity, chlorides, sulphates, organic matter					8	CO1
3	Ecological Instrumentation	Humidity measurement, rainfall measurement, pH meter, calorimeter, Principles of chromatography					6	CO2
4	Spectrophotometry	Spectrophotometer, Principle, Spectroscopy, UV-visible spectrophotometer, Atomic absorption spectrophotometer					8	CO2
5	Electrophoresis	Electrophoresis, Paper Electrophoresis, Gel Electrophoresis, Application of Electrophoresis					6	CO3
6	Instrumental Analysis	High-performance liquid chromatography (HPLC), Thin layer chromatography Gas chromatography, Application of HPLC					8	CO3
7	Water Analysis	Chemical water quality parameters: chloride, Ammonium, Nitrite, Nitrate, Phosphate, Hardness, Water testing methods					8	CO4
8	Air Analysis	Emission sources: Particulates, Lead, Ash, Nanoparticles, Gaseous Pollutants, Types of Air Sampling Equipments.					8	CO5
Reference Books:								
1-Chapin, F.S., Matson, P.A. and Mooney, H.A. 2002. Principles of Terrestrial Ecosystem Ecology. Springer-Verlag, New York.								
2-Clark, R.N. 1999. Spectroscopy of Rocks and Minerals, and Principles of Spectroscopy.								
3-U.S. Geological Survey, Denver								
4-John Wainwright and Mark Mulligan (Eds).2004. Environmental Modelling: Finding Simplicity in Complexity. John Wiley & Sons Inc., New York.								
5-Manahan, S.E. 2000. Environmental Chemistry. Seventh Edition. Lewis Publishers, NY								
6-Odum, E.P. (1971), Fundamentals of Ecology: Saunders, Philadelphia.								
e-Learning Source:								
https://www.slideshare.net/jov_inu/environment-analy								
https://slideplayer.com/slide/274533/								

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO																
CO1	2	2									1	2				
CO2	2	2									2	1				
CO3	1	2									2	2				
CO4	2	1									2	2				
CO5	1	1									2	2				

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

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

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

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

Course Outcomes

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

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

Reference Books:

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

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

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

e-Learning Source:

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

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

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

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO7
	CO1	3	3	2	2									2	3	3	3	
CO2	3	1	2	1									3	2	3	2		
CO3	3	2	3	1									2	3	2	3		
CO4	3	2	2	1									2	2	2	2		
CO5	3	2	2	2									2	3	2	3		

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

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

Course Code	B150405T /ES231	Title of the Course	Soil Conservation and its Management	L	T	P	C
Year	2nd	Semester	IV	3	1	0	4
Pre-Requisite	10+2	Co-requisite	NIL				
Course Objectives	<p>To develop the scientific attitude among the students for land and soil conservation. To develop attitude towards the fundamental education of soil among the students. To develop clear thinking about land use pattern awareness among the students.</p> <p>To develop attitude towards soil pollution, its degradation among the students.</p> <p>To provide knowledge to students about rational and scientific thinking about the measures to abate soil degradation.</p>						
Course Outcomes							
CO1	Students can enhance their knowledge about soil erosion and conservation.						
CO2	Students can increase their knowledge about soil and its related parameter in sustained manner without deteriorating soil health.						
CO3	Students can get efficient prospect to know about soil health and nature with development of new agricultural practices and technology.						
CO4	Restoration of ecological balance by harnessing, conserving and developing natural resources.						
CO5	To minimize soil erosion in the biodiversity rich areas and farm lands by implementing advance sustainable and government green practices.						
Unit No.	Title of the Unit	Content of Unit				Contact Hrs.	Mapped CO
1	Introduction	Land as a resource, soil health, types and causes of soil degradation; impact of soil degradation on agriculture and food security; need for soil conservation and restoration of soil fertility.				6	CO1
2	Fundamentals of soil science	Soil formation, classification of soil, physical properties of soil, soil texture, soil water holding capacity, soil temperature; soil colloids, soil acidity and alkalinity. soil organic matter, nutrients in soil: nitrogen, sulphur, potassium and phosphorus, soil biodiversity.				8	CO2
3	Soil degradation	Soil resistance and resilience, nature and types of soil erosion, losses of soil moisture and its regulation, nutrient depletion in soil, soil degradation due to mining and mineral extraction, toxic organic chemicals and organic contaminants in soils.				8	CO3
4	Land use pattern changes	Land resources: types and evaluation; biological and physical phenomena in land degradation; visual indicators of land degradation; drivers of land degradation-deforestation, desertification; habitat loss, loss of biodiversity, range land degradation, land salinization.				8	CO4
5	Human Activities	Human population pressure, poverty, socio-economic and institutional factors. Drivers of land use and land cover change in major geographic zones and biodiverse regions with particular reference to the Himalaya and the Western Ghats				8	CO4
6	Soil Conservation Practices	Crop Rotation, Contour ploughing, Cover cropping and Mulching, Conservation Tillage, Afforestation, Fertilizers and its management, Improving agricultural practices.				6	CO2
7	Sustainable Practices	Sustainable land use planning, role of databases and data analysis in land use planning control and management, land policy, Institutional and sociological factors, participatory land degradation assessment, integrating land degradation assessment into conservation.				8	CO5
8	Advanced methods for soil conservation	Organic farming, Grassed waterways, Chemical free farming, Integrated pest management, Government schemes- Rashtriya Krishi Vigyan Yojana, Cherrapunjee Ecological Project- Restoration of Degraded Lands under Sohra Plateau.				8	CO5
Reference Books:							
1.Brady, N.C. & Well, R.R. 2007.The Nature and Properties of Soils (13th edition), Pearson Education Inc.							
2.Gadgil, M. 1993. Biodiversity and India's degraded lands. Ambio 22: 167-172.							
3.Johnson, D.L. 2006. Land Degradation (2nd edition). Rowman & Littlefield Publishers.							
e-Learning Source:							
https://www.youtube.com/watch?v=RWw09HU5n2I							
https://www.youtube.com/watch?v=b3V988XYD-I							
https://www.youtube.com/watch?v=ValcMICikIw							

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

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

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

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

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

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

Reference Books:	
1. Odum, E.P. (1983), Basic Ecology, Sanders, Philadelphia.	
2. The Chemistry of Soils 3rd Edition by Garrison Sposito	
3. Practical Manual for Soil, Plant, Water and Seed Testing. P. Gurumurthy	

e-Learning Source:	
1. https://www.doccity.com/en/environmental-science-environmental-biology-lecture-notes/233205/	
2 http://www.rlbeau.ac.in/pdf/Horticulture/HNR%20131%20%20Fundamentals%20of%20Soil%20Science.pdf	

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																		
PO-PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
	CO																	
CO 1	3	1	1	2	1	1	2	-	-	-	-	-	3	1	1	1	3	-
CO 2	3	1	1	1	1	1	2	-	-	-	-	-	3	1	2	1	3	-
CO 3	3	1	1	1	1	2	2	-	-	-	-	-	3	1	2	1	3	-
CO 4	3	1	1	1	2	1	2	-	-	-	-	-	3	1	2	1	3	-

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

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

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

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

Pre-Requisite	Basic science	Co-requisite	NIL			
Course Objectives	The objective of Environmental Health & Safety course is to equip students with the necessary skills to ensure the health and safety of people and the environment related to working conditions or harmful substances. It helps the students to learn and recognize potential safety concerns before they become big problems. A well-educated student will not only will help in the prevention of catastrophic events, but also understand the importance of the prevention of injury and illness related to safety concerns.					
Course Outcomes						
CO1	Define health and its concept					
CO2	Describe a public health problem in terms of magnitude, person, time and place.					
CO3	Ability to provide industry with inputs on health and safety and understanding of ISO 14001 and its implications for an industry.					
CO4	Protocol development for an industry on disaster prevention, health issues, safety measures and environment management.					
CO5	Describe the role of social and community factors in both the onset and solution of public health problems					

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

Reference Books:	
Environmental, Health, and Safety Portable Handbook, Gayle Woodside, 1998, McGraw-Hill Professional	
Essentials of Environmental Health (Essential Public Health), by Robert H. Friis Mar 21, 2018	
Environmental Health: From Global to Local (Public Health/Environmental Health) by Howard Frumkin Feb 29, 2016	
Industrial Safety, Health and Environment Management Systems– 1 January 2000 by Prof. Sunil S.Rao & R.K.Jain (Author)	
Occupational Safety, Health And Working Conditions Code, 2020 Labour Laws, By Professionals Book Publishers	
Occupational Safety and Health: Fundamental Principles and Philosophies, Charles D. Reese, CRC Press	
e-Learning Source:	
SWAYAM	
MOOC	
e-SkillIndia	
Coursera	
Udemy	
National Digital Library of India	

Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1		2			2		3				3		2
CO2	3		2					2	3	2		2	
CO3	2				2			2					2
CO4			3			2		2			2	3	
CO5	3				3	2					3		3

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

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

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

Year	2nd	Semester	IV	2	1	0	3
Pre-Requisite	10+2	Co-requisite					
Course Objective	To provide different concepts of green technology and green chemistry. To acquire principles of Energy efficient technologies. To impart knowledge on the methods of reducing CO ₂ levels in atmosphere. To learn the importance of green fuels and its impact on environment. Basic actions to prevent the degradation of the environment and its harmful effects on humans.						
Course Outcomes							
CO1	Students are able to understand different concepts of green technology and green chemistry						
CO2	Students are able to understand acquire principles of Energy efficient technologies.						
CO3	Students are able to understand impart knowledge on the methods of reducing CO ₂ levels in atmosphere						
CO4	Students are able to understand learn the importance of green fuels and its impact on environment.						
CO5	Students are able to understand basic actions to prevent degradation of the environment and harmful effects on humans.						
Unit No.	Title of the Unit	Content of Unit				Contact Hrs.	Mappe d CO
1	Introduction to green chemistry and technology	Twelve principles of green chemistry, Green technology-definition, importance, factors affecting green technology. Role of industry, government and institutions; industrial ecology, role of industrial ecology in green technology.				6	CO1
2	Energy Sources	Introduction – renewable energy sources, non-renewable energy sources, non-conventional and inexhaustible energy resources. Geothermal energy, wind driven power station, Tidal power plants, Glacier power plants, solar energy, nuclear energy, natural radio activity, nuclear power plant, fast breeder reactors, nuclear fusion, Gobar gas.				8	CO2
3	Energy Management	Energy management – solar energy input conventional fuels – oil, coal, natural gas, uranium, risk of nuclear accidents				6	CO3
4	Bio energy	Bio energy – Biomass and bio fuels – Woody biomass for bio fuel - Biogas technology - Petro plants(energy plantations) used for bio fuel – Cellulosic ethanol production				6	CO4
5	Energy from wastes	Waste as renewable sources of energy- types of waste, classification based on chemical nature and physical state, composition of the waste, conversion of methane in to synthetic gas, factors effecting methane formation.				8	CO5
6	Cleaner development technologies	Cleaner development mechanisms, role of industry; reuse, reduce and recycle, raw material substitution; wealth from waste; carbon credits, carbon trading, carbon sequestration, eco labelling.				6	CO3
Reference Books:							
1-Calle FR, de Groot P, Hemstock SL, Woods J (2007) The Biomass Assessment Handbook: Bioenergy for a sustainable environment, Earthscan, UK.							
2-El Bassam N (2010) Handbook of Bioenergy Crops – A Complete Reference to Species, Development and Applications, Earthscan, UK							
3-Khanal SK, Surampalli RY, Zhang TC, Lamsal BP, Tyagi RD, Kao CM (2010) Bioenergy and Biofuel from Biowastes and Biomass, American Society of Civil Engineers, Virginia, USA.							
4-Lee S and Shah YT (2013) Biofuels and Bioenergy: Processes and Technologies, CRC Press, Boca Raton, FL, USA.							
e-Learning Source:							
https://www.youtube.com/watch?v=AODqoAhTXJA							
https://www.youtube.com/watch?v=jo_IRDLLSNU							
https://www.youtube.com/watch?v=JABjhJHX8Tc							
https://www.youtube.com/watch?v=9opyTo7ZIJY							

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

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

Name & Sign of Program Coordinator	Sign & Seal of HoD
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