

Following Vocational Courses and Syllabi have been introduced as per NEP-2020

S.No	COURSE CODE	COURSE NAME	INTRODUCED IN YEAR
1.	I150106T/ES131	Introduction to Natural Hazard and Disaster Management	1st year B.Sc. EVS
2.	I150107T/ES132	Water Monitoring and Conservation Techniques	1st year B.Sc. EVS
3.	I150207T/ES139	AI for Earth and Environmental Sciences	2nd year B.Sc. EVS
4.	I150208T/ES140	Ecotourism and Wildlife Management	2nd year B.Sc. EVS
5.	I150307T/ES224	Environment and Economics	3rd year B.Sc. EVS
6.	I150308T/ES226	Environment and Sustainability	3rd year B.Sc. EVS
7.	I150407T/ES233	Environment, Health, and Safety	4th year B.Sc. EVS
8.	I150408T/ES234	Green Technology	4th year B.Sc. EVS



Integral University, Lucknow
Department of Environmental Science

Effective from Session:2023-2024																			
Course Code	I150106T/ES131		Title of the Course	Introduction to Natural Hazard and Disaster Management					L	2	T	1	P	0	C	3			
Year	1st		Semester	I					2	1	0	3							
Pre-Requisite	Basic science		Co-requisite	NIL															
Course Objectives	1. To impart basic knowledge of concept of Hazard, risk and vulnerability. 2. To understand types of hazards, its causes and impact. 3. Assessment of risk and vulnerability. 4. Acquiring knowledge about mitigation and preparedness to combat disaster. 5. To aware about role of government bodies in disaster management.																		
Course Outcomes																			
CO1	Gain basic knowledge of concept of Hazard, risk and vulnerability.																		
CO2	Acquired knowledge of hazards its impact.																		
CO3	Understand about Assessment of risk and vulnerability related to disaster.																		
CO4	Formulate, organize and assess disaster Risk reduction activities																		
CO5	Demonstrate and practice Disaster Management.																		
Unit No.	Title of the Unit	Content of Unit												Contact Hrs.	Mapped CO				
1	Concept of Disaster and Vulnerability	Hazard and disaster -Concept; risk and vulnerability; Types of hazards-Natural hazards: hydrological, atmospheric & geological hazards, Causes of Earthquake, floods, cyclone, tsunami, landslides, and drought.												10	CO1				
2	Impact of Disaster	Global and National Perspective. Disaster profile of India, Case studies from Disasters, Large Hydro projects and its risks-Uttarakhand Dsisaster-2013.												10	CO2 CO3				
3	Disaster Management	Component of Disaster Management-Preparedness and Mitigation, Phases of Disaster Management. Compensation and Insurance.												10	CO4 CO5				
4	Intervention of technologies	Application of geoinformatics in hazard, risk & vulnerability assessment. Early warning System; PTWS & IMD.												10	CO5				
5	Disaster Risk Reduction	Approaches to Disaster risk Reduction (DRR)- Role of public, education and media in DRR. Community Based DRR,International/National Humanitarian aid.												10	CO4				
6	Disaster Act. And Policies	National Acts and policies for mitigating Disasters (Disaster Management Act 2005, National Policy for Disaster Management-2009, Institutional Framework for disaster management (NDMA, SDMA, SDMA &NIDM).												10	CO5				
Reference Books:																			
1-Coppola D. P. 2007. Introduction to International Disaster Management. Butterworth Heinemann.																			
2-Cutter, S.L. 2012. Hazards Vulnerability and Environmental Justice. EarthScan, Routledge Press.																			
3-Keller, E. A. 2012. Introduction to Environmental Geology. Prentice Hall, Upper Saddle River, New Jersey.																			
4-Pine, J.C. 2009. Natural Hazards Analysis: Reducing the Impact of Disasters. CRC Press, Taylor and Francis Group.																			
5-Schneid, T.D. & Collins, L. 2001. Disaster Management and Preparedness. Lewis Publishers, New York, NY.																			
6-Smith, K. 2001. Environmental Hazards: Assessing Risk and Reducing Disaster. Routledge Press.																			
7-Wallace, J.M. & Hobbs, P.V. 1977. Atmospheric Science: An Introductory Survey. Academic Press, New York.																			
e-Learning Source:																			
https://www.researchgate.net/publication/323794760_Natural_Hazards_and_Disaster_Management																			
https://link.springer.com/article/10.1007/s11069-019-03677-2																			
https://ndmindia.mha.gov.in/images/public-awareness/Primer%20for%20Parliamentarians.pdf																			
SWAYAM MOOC, e-Skill India, Coursera, Udemy,NPTEL																			
Course Articulation Matrix: (Mapping of COs with POs and PSOs)																			
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PS O6	
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
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Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2023-2024							
Course Code	I150107T/ES132	Title of the Course	Water Monitoring and Conservation Techniques	L	T	P	C
Year	1 st	Semester	I	2	1	0	3
Pre-Requisite	10+2	Co-requisite	Basic knowledge of water				
Course Objectives	The objective of this course is to impart knowledge of hydrology that deals with the occurrence, distribution, movement, and properties of water on the earth. The students will also be aware of different water quality standards for the application of water in different sectors. It is expected to give an exposure to students of social and natural sciences and humanities for better understanding of water resources, water economics, water governance and policy.						
Course Outcomes							
CO1	Describe the role water plays in the lithosphere, hydrosphere, cryosphere, atmosphere, and biosphere, with emphasis on interactions between these reservoirs.						
CO2	Apply the scientific method to investigations of hydrologic processes, Earth systems, and interactions among the various physical and biological realms utilizing standard scientific field and laboratory methods.						
CO3	Plan water quality surveillance for a given aquatic environment and to understand what a test result means in terms of the health of the ecosystem. water quality and water quality criteria and standards, and their relation to public health, environment, and urban water cycle						
CO4	Use their knowledge environment, research skills to current issues pertaining to water resources, management, and remediation, with emphasis on related economic, social, and public policy dimensions.						
CO5	Analyze, interpret, and report on laboratory and field findings using appropriate statistical techniques and computer applications.						
Unit No.	Title of the Unit	Content of Unit				Cont act Hrs.	Mapped CO
1	Introduction to water	Origin of water on earth, Unique properties of water (Polarity, Cohesion, Density, Surface Tension, Viscosity, Heat capacity, Boiling and freezing points, Temperature, Taste, Odour, Colour). Importance of water in human civilization (Mesopotamian and Indus), Water catastrophes: Historical perspective and consequences, Water infrastructure and tools (Ancient, Medieval and modern).				9	CO1 & 2
2	Hydrology and hydrological cycle	Concept and scope of hydrology, Hydrological cycle: Evaporation: Process, Factors effecting evaporation, Measurement of evaporation, Transpiration: process, Factors affecting transpiration, Condensation: Process and measurement, Precipitation: Process, Types and forms, Measurement and distribution,				9	CO, 2& CO5
3	Water conservation Practices	Rainwater harvesting methods, classes, benefits, approach, water saving technologies, rainwater harvesting and drought mitigation, crop productivity and water security. Concept and definition of watershed, importance of watershed management and its role in conservation of natural resources. Methods of irrigation - surface, subsurface, sprinkler, drip and pitcher. Reducing water losses, water resource in India, water budget in India, planning and optimum use of water resources.				11	CO2, 3 & 5
4	Water resources and sustainable development	Water as a resource, Dublin-Rio Principles on Water and Sustainable Development, Brief account of concept of water stress, scarcity, water footprint and virtual water trade, Right to Water (SDG-6); Entitlements and criteria, Concept and overview of Water, Sanitation and Hygiene (WASH), Swachh Bharat Mission and National Water Mission,				9	CO 2,3,4 & 5
5	Water Resource: Governance and Policy	Water Governance: Elements and dimensions of water governance; Effective water governance schemes; Indicators of good governance. Water Governance in India: Salient features of National water policy 2012 and Jammu and Kashmir Water Resource (Regulation and Management) act 2010, Conflicts in Water Pricing: Conflicts on subsidy verses sustainability, overview of global water conflicts and interstate water conflicts in India.				11	CO4 & CO5
6	Water Economics	Valuing of water: The use and non-use values of water, Introduction to water valuation methods: Non-revenue waters (NRW) and unaccounted for water (UFW); Metering water uses; Water management through economic instruments. Water Pricing - Approach and Models: Significance of water pricing Water pricing models - flat rate and uniform rate, Brief account of water pricing practices in India and abroad.				11	CO5
Reference Books:							
Standard methods for the examination of water and wastewater published by APHA 15th ed.							
Keith, L.H. [Ed.] 1988 Principles of Environmental Sampling. American Chemical Society							
Mays, L.W. 2006. Water Resources Sustainability. The McGraw-Hill Publications.							
Schward and Zhang, 2003. Fundamentals of Groundwater. John Willey and Sons.							
Souvorov, A.V. 1999. Marine Ecogonomics: The Ecology and Economics of Marine Natural Resource Management. Elsevier Publications. Vickers, A. 2001.							
Handbook of Water Use and Conservation. Water Plow Press.							
Gleick, P. H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.							
e-Learning Source:							
SWAYAM, MOOC, e-Skill India, Coursera, Udemy, National Digital Library of India							

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

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

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

Effective from Session: 2023-2024							
Course Code	I150207T/ ES139	Title of the Course	AI for Earth and Environmental Sciences	L	T	P	C
Year	1 st	Semester	II	2	1	0	3
Pre-Requisite	10+2	Co-requisite	None				
Course Objectives							

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	Artificial Intelligence	Concept and definition of AI, Basics of Python/Git, Linear/Logistic Regression for Classification/Regression & Bias-Correcting Forecasts	9	CO1 & 2
2	Machine Learning	Concepts of machine learning, regression ML techniques, classification ML techniques, clustering ML techniques, ML and fairness	9	CO, 2& CO5
3	Applications of AI & ML	Healthcare, Transport, Banking and finance, Security, Education, Robotics, Agriculture, E-commerce, poverty, homelessness, and social media	11	CO2, 3 & 5
4	Applications of AI & ML in Environment	Using AI 'guardians' to save trees, reducing carbon footprint of steel, Energy waste reduction, Tackling poaching, smart agriculture, Plotting clouds using computers, environmental sustainability (biodiversity, climate, water, forests), disasters and climate change.	9	CO 2,3,4 & 5
5	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.	11	CO4 & CO5
6	Hands on training	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.	11	CO5

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 Udemmy 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
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
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Integral University, Lucknow
Department of Environmental Science
Effective from Session: 2023-2024

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

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

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mappe dCO
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 ecotourism on Economy.	08	3
5	Wildlife Conservation	Wildlife conservation - Protected Areas Network in India - Goals of management, Strategies for planning.	08	4
6	Factors influencing wildlife management	Factors influencing wildlife management such as habitats, population, behaviour, food- habits health etc. Tools for data collection and analysis.	06	4
7	Wildlife Management	Wildlife Management process, elements of wildlife management in India. Role of local communities in Wildlife management.	08	5
8	Wildlife conflicts	Man-wildlife conflicts – Poaching of wildlife – Wild life conservation laws – The Wildlife (Protection) Act, 1972 (2002 amendment).	08	5

Reference Books:

1-Dasma RF (1968) Environmental Conservation Joh Wiley and Sons New York.
 2-Mukherje N (2008) Ecotourism and s sustainable 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 and III, Anmol Publication Pvt. Ltd., New Delhi.
 5-Weaver DB (2001) The Encyclopedia of Ecotourism, CABI Publishing, UK.

e-Learning Source:

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

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																			
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
CO1	2	2	2	2	2	2	1	-	-	-	-	-	2	2	2	2	2	-	
CO2	3	2	2	2	2	2	1	-	-	-	-	-	2	1	1	2	2	-	
CO3	3	3	2	2	2	2	2	-	-	-	-	-	2	2	1	2	1	-	
CO4	3	3	3	2	3	2	2	-	-	-	-	-	3	3	2	3	1	-	
CO52	2	2	2	2	2	3	1	-	-	-	-	-	2	3	3	2	3	-	

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

Name & Sign of Program Coordinator	Sign & Seal of HoD
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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	2 nd	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 Foot Print, 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 Programmes, 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 viz. 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_IEEP_K3736-Demo/module/pdfs/p570_unit_01.pdf
- 2- https://www.sfu.ca/~wainwrig/Econ400/documents/Econ_460_Lecture-Notes-part_One-10-3.pdf
- 3- <https://ocw.mit.edu/courses/economics/14-42-environmental-policy-and-economics-spring-2011/lecture-notes/>
- 4- <https://nptel.ac.in/courses/109107171/>

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																		
PO-PSO CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO 4	PSO5	PSO6
	CO1	3	1	2	1	1	1	3	-	-	-	-	-	3	1		3	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	2 nd	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.	09	CO2, 3 & 5
4	Sustainable Energy	Sustainable energy: Non-conventional Sources, Energy Cycles, carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socioeconomic and technological change.		
5	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.	09	CO 2,3,4 & 5
6	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.	12	CO5 & CO5

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, Udemey, 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
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
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Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2023-24							
Course Code	1150407T/ 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-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
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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	2 nd	Semester	IV	2	1	0	3
Pre-Requisite	10+2	Co-requisite	NIL				
Course Objectives	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.	Mapped CO
1	Introduction to green chemistry and technology	Twelve principles of green chemistry, Green technology-definition, importance, factors affecting green technology. Role of industry, government and institutions; industrial ecology, role of industrial ecology in green technology.	6	CO1
2	Energy Sources	Introduction – renewable energy sources, non-renewable energy sources, non-conventional and inexhaustible energy resources. Geothermal energy, wind driven power station, Tidal power plants, Glacier power plants, solar energy, nuclear energy, natural radio activity, nuclear power plant, fastbreeder 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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