



Integral University, Lucknow

Effective from Session: 2017-2018							
Course Code	ES401	Title of the Course	Advanced Studies in Environment and Ecology	L	T	P	C
Year	I	Semester	I	3	1	0	4
Pre-Requisite	B.Sc./B.Sc. (Hons.) with Biological Science (Zoology, Botany, Chemistry)/Life Sciences/Biotechnology/Microbiology /Agriculture/ Anthropology	Co-requisite					
Course Objectives	1.Understand how interactions between organisms and their environments drive the dynamics of individuals, populations, communities, and ecosystems. 2. Recognize the ecological basis for regional and global environmental issues. 3. Understand the processes and patterns of evolution, and the role of evolution as the central unifying concept in environmental science. 4. Understand the Importance and also the the techniques to protect natural Resources						

Course Outcomes	
CO1	Develop empathy for various life forms and appreciate the various ecological linkages within the web of life.
CO2	Apply the scientific method and quantitative techniques to describe, monitor and understand environmental systems.
CO3	Use interdisciplinary approaches such as ecology, economics, ethics and policy to devise solutions to environmental problems.
CO4	Be proficient in ecological field methods such as wildlife survey, biodiversity assessment, mathematical modeling and monitoring of ecological systems.
CO5	Explain the process and philosophical basis of scientific inquiry.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	Environmental Science - Definition, Scope and Importance - Components of the environment: Atmosphere, Hydrosphere, Lithosphere and Biosphere – Structure and composition - History and scope of Ecology - Terminologies in ecology.	8	CO1
2	Functional Aspects of Ecosystem	Functional aspect of ecosystem analysis; Energy flow (food chain, food web, ecological pyramid), energy resources and use efficiency, ecological energetic and energy models, Biomass production (gross and net), biomass estimation methods, Litter production and decomposition in different ecosystem, Biogeochemical cycles (nutrient cycle: carbon, nitrogen, sulphur, phosphorus, hydrological cycle); Homeostasis.	8	CO2
3	Population ecology	Population ecology - Levels of Organization, population characteristics - density, natality, mortality, survivorship curves, age distribution, growth curves and models - Population interactions - Coevolution, Neutralism, symbiosis, commensalism, mutualism, antagonism, antibiosis, parasitism, predation; competition- inter and intra specific.	8	CO3
4	Resource Depletion	Natural resources-definition and types, Natural resources degradation-types and causes, loss of biodiversity, land degradation, deforestation, ecological and social impact of resource depletion.	8	CO4
5	Public Participation In Restoration	Role of public participation, government agencies and NGOs in conservation and restoration, environmental education and its role in conservation and restoration.	8	CO5

Reference Books:	
1-Jha LK (1997) Natural Resource Management. APHA Publishing Corporation	
2.-Odum EP (1996) Fundamentals of Ecology. W.B. Saunders	
3-Ramade F (1991) Ecology of Natural Resources. John-Wiley & Sons	
4-Rana SVS (2005) Essentials of Ecology and Environmental Sciences	
e-Learning Source:	
https://www.advancedresearchpublications.com/publish-jaraeee	
https://journals.indexcopernicus.com/journal/49030	
https://link.springer.com/book/10.1007/978-3-030-65181-7	
https://esajournals.onlinelibrary.wiley.com/journal/15409309	

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

Effective from Session: 2017-2018							
Course Code	ES402	Title of the Course	Energy and Green Technologies	L	T	P	C
Year	I	Semester	I	3	1	0	4
Pre-Requisite	B.Sc./B.Sc. (Hons.) with Biological Science (Zoology, Botany, Chemistry)/Life Sciences/Biotechnology/Microbiology /Agriculture/ Anthropology.		Co-requisite				
Course Objectives	To present different concepts of green technologies. 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 degradation of the environment and harmful effects on humans						

Course Outcomes	
CO1	Students are able to understand different concepts of green technologies
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	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	CO3
2	Energy Management	Energy management – solar energy input conventional fuels – oil, coal, natural gas, uranium, risk of nuclear accidents	8	CO2
3	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	8	CO4
4	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
5	Green Chemistry	Biotic interactions, bio film, Green chemistry - Introduction- inception and evolution - Importance of solvents - Types of catalysts and their role - Biological alternatives – Applications - Principles of green chemistry, Advances in green chemistry	8	CO1

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

Effective from Session: 2017-18							
Course Code	ES403	Title of the Course	Basics of Environmental Microbiology	L	T	P	C
Year	I	Semester	1	3	1	0	4
Pre-Requisite	B.Sc./B.Sc.(H) with Environmental Science/Botany/Zoology/Chemistry/Geology/Physiology/Microbiology/Agriculture/Anthropology having a minimum of 50% marks in the aggregate from a recognized Board/University.		Co-requisite				
Course Objectives	1. To know about historical events in microbiology, structural detail of prokaryotic and eukaryotic cell and to understand microbial growth, multiplication and sterilization techniques. 2. Study of different microbial interaction and importance of Soil micro flora. 3. Role of microbes in nutrient cycling. 4. To assess impact of microbes on quality of air and water. 5. Uses of microbes for degradation and utilization of waste material						
Course Outcomes							
CO1	Get an idea about the historical events in microbiology. Students will be able to understand structural detail of prokaryotic and eukaryotic cell and to understand microbial growth, multiplication and sterilization techniques.						
CO2	Know concepts related with of microbial interaction • Get an idea regarding microbes and their relation with environment.						
CO3	Create a knowledge and understood role of microbes in nutrient cycling.						
CO4	Students will be able to assess impact of microbes on quality of air and water.						
CO5	Able to explore various uses of microbes for degradation of waste material						
Unit No.	Title of the Unit	Content of Unit				Contact Hrs.	Mapped CO
1	Introduction	History and scope of microbiology - Ultra structure of Prokaryotic and Eukaryotic cell - Sterilization techniques used in microbiology - Preparation of media for isolation and culture of microorganisms, Microbial growth and multiplication of bacteria, virus and fungi – Nature of virulence, toxins, extra cellular enzymes of pathogenic bacteria				8	CO1
2	Geo-microbiology	Distribution of microorganisms in soil - Factors influencing the soil microflora – Role of microorganisms in soil fertility - Interactions among microorganisms: Mutualisms, commensalism, competition, amensalism, parasitism, predation - Interactions between microbes and plants: Rhizosphere, phyllosphere, mycorrhizae				8	CO2
3	Biogeochemical Cycles	Biogeochemical cycles: Carbon cycle - Role of microbes in carbon cycle - Nitrogen cycle - Mechanism of biological nitrogen fixation – Ammonification, nitrification, denitrification and microorganisms involved in such processes - Phosphorous cycle and Sulphur cycle.				8	CO3
4	Air and Water-borne Diseases	Microbial air pollutants – Bio aerosols, Aero allergen - Airborne diseases, Symptoms and preventive measures - Water pollution: Sources and nature of pollutants in water – waterborne diseases. Assessment of microbiological quality of water - MPN technique and Biological Oxygen Demand. Domestic solid (compost) and liquid waste treatment – Eutrophication				8	CO4
5	Applied Microbiology	Microbial conversion of solid waste to food (Mushroom, SCP), fuels (Biogas, Ethanol), Bioleaching of Ores, Biodegradation of Lignin – Pesticides – Recalcitrant – Bioremediation: Types and its application – Bio deterioration of paper, wood and paints - Metal corrosion				8	CO5
Reference Books:							
1-Subba Rao NS (2004) Soil Microbiology. 4th Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.							
2-Subba Rao NS (1995) Biofertilizers in Agriculture and Forestry. 3rd Edition, Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.							
3-Robert L Tate (1995) Soil Microbiology. 1st Edition, John Wiley & Sons, Inc. New York.							
4-Atlas RN & Bartha R (1998) Microbial Ecology, 4th Edition, Benjamin Cummings.							
5-Jogdand SN (2004) Environmental Biotechnology. Reprinted & Published by Himalaya Publishing House, Mumbai.							
6-Singh DP & SK Dwivedi (2005). Environmental Microbiology and Biotechnology. 1st Edition, New Age International (P) Ltd., Publishers, New Delhi.							
e-Learning Source:							
https://onlinecourses.nptel.ac.in/noc21_ce07/preview							
https://archive.nptel.ac.in/content/storage2/courses/pmr/105107173/noc22-ce15_week2.pdf							
https://www.pdfprof.com/PDF_Image.php?id=7868&t=27							
https://www.nitttrc.edu.in/nptel/courses/video/105107173/lec2.pdf							

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

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

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

Effective from Session: 2018-2019							
Course Code	CH404	Title of the Course	Environmental Chemistry	L	T	P	C
Year	I	Semester	I	3	1	0	4
Pre-Requisite	B.Sc./B.Sc.(H) with Environmental Science/Botany/Zoology/Chemistry/Geology/Physiology/Microbiology/Agriculture/Anthropology having a minimum of 50% marks in the aggregate from a recognized Board/University		Co-requisite				
Course Objectives	The main objectives of this course is to study various types of pollutants, their sources, effects on living and non-living species and related control measures.						

Course Outcomes	
CO1	Understand the fundamental concepts of Environmental chemistry.
CO2	Evaluate different types of air pollutants, their harmful effects on living and non living species, their control measures; Study of Global Warming, Green House Effect and Ozone Layer Depletion.
CO3	Analyze the various factors of water quality assessment parameters, water pollutants and their sources.
CO4	Understand the importance of soil composition; Analyze various types of soil pollutants, their control and related standards.
CO5	Understand the Principles of commonly used analytical methods in environmental quality assessment

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Chemistry For Environment	Fundamental of environmental chemistry: Mole Concept, Solution chemistry, solubility product, Solubility of gases, Phase change, thermodynamics, Electrochemistry and redox reactions, Gibbs' free energy; Chemical potential; chemical kinetics and chemical equilibrium. Sources of natural and artificial radiations. Applications and handling of isotopes and other radionuclides in environment.	8	1
2	Atmospheric Chemistry	Chemical composition of air, Classification of elements, chemical speciation. Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Thermo-chemical and photochemical reactions in the atmosphere. CFC's and Ozone chemistry, chemistry of air pollutants, photochemical smog.	8	2
3	Environmental aspects of water-chemistry	Structure and properties of water, Water quality parameters, Physicochemical concepts of color, odour, turbidity, pH, conductivity, DO, COD, BOD, alkalinity, carbonate system in water, total hardness and redox reactions	8	3
4	Environmental aspects of soil-chemistry	Soil formation, composition and classification; Soil profile; Soil erosion; Inorganic and Organic components of soil -Nitrogen pathways in soil; NPK in soils.	8	4
5	Principles of commonly used analytical methods in environmental quality assessment	Titrimetry; Gravimetry; Colorimetry; Spectrophotometry; Flame photometry; Atomic absorption spectrophotometry; Basic Chromatography; GC; GLC, HPLC; Electrophoresis; X-Ray fluorescence, X-Ray diffraction; Inductive coupled plasma spectroscopy.	8	5

Reference Books:

- 1-Environmental Chemistry Manahan, Stanley E, 2004, Taylor & Francis Ltd.
- 2-Basic Concepts of Environmental Chemistry, Desley W. Connell, 1 edition, CRC-Press
- 3-Environmental Chemistry: A Global Perspective, Gary W. Vanloon Stephen J. Duffy, Oxford Univ Pr (Sd).
- 4-Introduction to Environmental Chemistry, Reid, Brian J. Blackwell ScienceLtd.
- 5-Chemistry of the Environment, Thomas G. Spiro, William M. Stigliani, 2nd Edition, Prentice Hall publication

e-Learning Source:

<http://textofvideo.nptel.ac.in/104105033/lec39.pdf>
<http://nptel.ac.in/courses/104101006/downloads/lecture-notes/mod10/lec3.pdf>
<https://www.youtube.com/watch?v=1jRo5fTg0KY>

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

Effective from Session: 2017-18							
Course Code	ES404	Title of the Course	Climate Change & Current Issues	L	T	P	C
Year	I	Semester	I	3	1		4
Pre-Requisite	B.Sc./B.Sc.(H) with Environmental Science/Botany/Zoology/Chemistry/Geology/Physiology/Microbiology/Agriculture/Anthropology having a minimum of 50% marks in the aggregate from a recognized Board/University		Co-requisite				
Course Objectives	The purpose of this course is to impart basic and key knowledge of Climate Change and Current Issues. This will help in enhancing knowledge of elements of Climate and Impact of Human activities on Climate, extreme events of Climate Change, mitigation measures adopted against Global warming and Climate Change and Generate Knowledge for actions to be taken at National and Global Level for reducing impacts of Climate Change. After successfully completion of course, the student will able to explore subject into their respective dimensions.						
Course Outcomes							
CO1	Students will be able to Analyse through study of Elements of Climate, impact of Human activities on World Climate.						
CO2	Students will be able to Analyse contributions of extreme events of Climate on Earth in bringing about changes in Climate.						
CO3	Create a knowledge base for Global and National Action Plans to combat climate Change Issues						
CO4	Students will be able to Evaluate the role of Remedial Measures in Combating Global Warming and Climate Change.						

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Elements and Components of Climate Change	Elements of climate: Temperature, precipitation, atmospheric circulation and atmospheric chemistry– Components of climate change processes: Human activities (Fossil fuel burning, industrial processes, land use), Natural influences (Plate tectonics, orbital cycles, ocean circulation, solar variability), Natural aerosols (volcanoes, sea spray and dust) and Natural greenhouse gases - Radioactive forcing - Classification of climate: Koppen's and Thornthwaite' scheme	8	CO1
2	Surface and Atmospheric Climate Change	Air masses: Definition, Classification of air masses, Types of air masses – Fronts: Definition, Types of fronts - SW and NE monsoon - Jet stream, tropical and extra-tropical cyclone - Extreme events of climate change: Heat and cold waves, drought, floods, hurricanes – Recent extreme events in the world – El Nino, La Nina and ENSO - Global consequences of El Nino	8	CO2
3	Global Warming	Global warming and climate change: Green house gases – Green house effect and climate change – Facts and figures of current global warming scenarios in the world – Remedial measures to control/combat global warming – India's Forest and Tree cover contribution as a carbon sink.	8	CO4
4	Climate Change and its Impacts	Climate change impact on water and food security – Climate change impact on species extinction – Climate change impact on human health – Global Climate Risk Index	8	CO3
5	Global/National Action Plans to Combat Climate Change Issues	Key steps taken by UNFCCC to combat climate change: Kyoto Protocol – Bali Action Plan 2007 – Cancun Agreements 2010 – Durban outcomes – Doha Climate Gateway 2012 – Warsaw outcomes 2013 – Green climate funds – Clean Development Mechanism (CDM) – Climate Change, Information Network (CCiNet) – National Action Plan on Climate Change – Recent Initiatives related to climate change in India.	8	CO3

Reference Books:

1. Barrie Pittock A (2009) Climate Change: The Science
2. Botkin DB (1989) Changing the Global Environment
3. Cowie J (2007) Climate Change: Biological and Human Aspects
4. Dogra N Srivastava S (2012) Climate Change & Disease Dynamics in India
5. Filho WL (2012)

e-Learning Source:

1. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/119106008/lec40.pdf
2. <http://www.fao.org/3/CA2607EN/ca2607en.pdf>
3. <http://moef.gov.in/wp-content/uploads/2019/08/Annual-Report-2018-19-English.pdf>

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

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

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

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

Effective from Session: 2017-2018							
Course Code	ES405	Title of the Course	Environmental Ecology Lab	L	T	P	C
Year	I	Semester	I	0	0	8	
Pre-Requisite	B.Sc./B.Sc.(H) with Environmental Science/Botany/Zoology/Chemistry/Geology/Physiology/Microbiology/Agriculture/Anthropology having a minimum of 50% marks in the aggregate from a recognized Board/University	Co-requisite					
Course Objectives	To know the basic guidelines, principles of working in lab along with proper handling of instruments. To develop student interest in field of environment ecology by conducting various experiments associated. To provide the experimental knowledge to students about microbiology.						

Course Outcomes	
CO1	Apply the scientific knowledge to know the rules and regulation while working in lab and the protocol of sterilization of an instrument.
CO2	Develop practical knowledge about difference between prokaryotic and eukaryotic cells and to estimate BOD and COD
CO3	Develop practical knowledge to determine the minimum quadrat size for community study. To know the method of estimation of pH and conductivity, total Suspended Solids & total Dissolved Solids.
CO4	Gain knowledge about the general instructions, Microbiology laboratory and its discipline. To understand the Handling of microscopes, Calibration and measurement of microscopic objects.
CO5	Develop practical knowledge to Enumerate bacteria, fungi from soil samples. To know how to Isolate Rhizobium from nodules and to estimate chlorophyll.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	To know the rules and regulation while working in lab and the protocol of sterilization of an instrument.	8	1
2	Study of cell	To understand the difference between prokaryotic and eukaryotic cells and to estimate BOD and COD	8	2
3	Estimation of Quadrat and Biochemical Analysis	To determine the minimum quadrat size for community study. To know the method of estimation of pH and conductivity, total Suspended Solids & total Dissolved Solids.	8	3
4	Fundamental of Microbiology	To know the general instructions, Microbiology laboratory and its discipline. To understand the Handling of microscopes, Calibration and measurement of microscopic objects.	8	4
5	Isolation of microbes and chlorophyll estimation	To Enumerate bacteria, fungi from soil samples. To know how to Isolate Rhizobium from nodules and to estimate chlorophyll.	8	5

Reference Books:

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

e-Learning Source:

- <chrome-extension://efaidnbmninnbpcjpcglefndmkaj/https://www.ijsr.net/archive/v4i11/NOV151021.pdf>
- https://chem.libretexts.org/Courses/Brevard_College/CHE_104%3A_Principles_of_Chemistry_II/07%3A_Acid_and_Base_Equilibria/7.07%3A_pH_Calculations_pH_measurement_and_pH_estimation
- <https://pharmastate.academy/dos-donts-in-microbiology-lab/#:~:text=Avoid%20coughing%2C%20sneezing%20and%20yawning,unwanted%20articles%20along%20with%20you.>

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

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

Effective from Session: 2017-18								
Course Code	ES406		Title of the Course	Natural Resources and Management	L	T	P	C
Year	I		Semester	II	3	1	0	4
Pre-Requisite	Environment & Ecology		Co-requisite					
Course Objectives	1. Imparting 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 Role of government bodies in disaster management.							
Course Outcomes								
CO1	Students will be able to introduced and aware from different types resources and its distribution.							
CO2	Students will be able to analyse soil resources and how soil quality get affected by different factors/events.							
CO3	Understand sustainable exploration, use and conservation of different types of mineral resources.							
CO4	Students will be able to know about importance of water resources, Remedial Measures in conserving water resources.							
CO5	The knowledge can be used to prevent deforestation and long-term measures for productivity and conservation of forest resources.							
Unit No.	Title of the Unit	Content of Unit					Contact Hrs.	Mapped CO
1	Introduction	Natural resources – Classification, Concepts and approaches of natural resource conservation -Natural resources of India					8	CO1
2	Soil Resources Management	Distribution of Soil resources – Role of agricultural practices in soil degradation - Soil erosion – Soil Fertility and Nutrient Management: Role of organic matter and its significance in soil quality – Diagnosis of soil nutrient deficiencies – Organic Farming: Principles, Benefits and Methods of organic farming; Green manuring, Animal manures and Composting -Wasteland development strategies.					8	CO2
3	Mineral Resources Management	Resources and reserves – Origin, distribution and uses of economic minerals -Exploration of mineral resources from oceans - Steps in mineral exploitation, Impact of exploitation of economic minerals on environment - Conservation of economic mineral resources.					8	CO3
4	Water Resources Management	Integrated water resource management -Watershed management –Rainwater harvesting – Interlinking of rivers and river basin management - Wetland conservation – Coastal zone management strategies - Ecological significance of mangroves, Coral reefs and its conservation					8	CO4
5	Forest Resources Management	Significance for the conservation of forest resources – Distribution of forests, Wood production, Forest land use changes in India, Future demand of forest land, Carbon sequestration - Forest management tools: Social forestry, Agro-forestry and Urban forestry - Eco development committees, Ecotourism, Climate change reduction, Carbon trading and management of grasslands					8	CO5
Reference Books:								
1- Dutta A (2001) Biodiversity and ECOSystem Conservation. Kalyani Publisher, Kolkata.								
2- Jha LK (1997) Natural Resource Management. APH Publishing Corporation, New Delhi.								
3-Kumar HD (1995) Modern Concepts of Ecology. Vikas Publishing House (P) Ltd., New Delhi.								
4.-MaDicken KG and Vergora NT (1990) Agroforestry: Classification & Management. John Wiley & Sons, New York.								
5- Nalini KS (1993) Environmental Resources and Management, Anmol Publications (P) Ltd., New Delhi.								
6-Nautiyal S and Kaul AK (1999) Forest Biodiversity & its Conservation Practices in India.								
e-Learning Source:								
https://www.sciencedirect.com/topics/earth-and-planetary-sciences/natural-resource-management								
http://www.ciesin.org/decentralization/English/Issues/NRM.html								
http://web.worldbank.org/archive/website00675/WEB/PDF/ENVST-18.PDF								
https://www.researchgate.net/publication/294369522_Integrated_Soil_and_Water_Resource_Management_for_Livelihood_and_Environmental_Security								
https://www.isric.org/utilise/global-issues/water								
https://www.mdpi.com/journal/resources/special_issues/Mineral_Resource_Assessment_Mining_Processing								
https://www.ntnu.edu/studies/courses/TGB4255#tab=omEmnet								

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

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

Effective from Session: 2017-18							
Course Code	ES407	Title of the Course	Disasters, mitigation and Management	L	T	P	C
Year	I	Semester	II	3	1	0	4
Pre-Requisite	Ecosystem and Technology	Co-requisite					
Course Objectives	To provide basic concept about types of Natural and Man-made Disaster. To develop basic knowledge about Disaster Risk Reduction. . To provide knowledge about role of disaster medicine and disaster medical management. To provide knowledge about Disaster Epidemiology Environmental health hygiene during Disaster. To develop knowledge about Role of NDRF for disaster management.						
Course Outcomes							
CO1	Student will be able to learn Economic impact of Disasters. Relationship between Disaster and Development.						
CO2	Student will be able to learn Disaster Risk Reduction Master Planning for Sustainable development						
CO3	Student will be able to learn role of disaster medicine during Natural and Man-made Disaster						
CO4	Be able to learn Disaster Epidemiology Environment health hygiene during disaster						
CO5	Student will be able to learn Role of National Institute of Disaster Management and Disaster Response Force during Disaster						

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Disaster	Concepts of Hazard, Vulnerability, Risks, Natural Disasters, and Man Made Disaster, Technological disasters, Risks, Political, Social, Economic impacts of Disasters, Equity issues in disasters, Relationship between Disasters and Development and vulnerabilities, Human Resettlement and Rehabilitation issues during and after disasters, Inter-sectoral coordination during disasters.	8	CO1
2	Approaches to Disaster Risk Reduction	Disaster Risk Reduction Strategies, Disaster Cycle, Phases of Disaster, Preparedness Plans, Action Plans and Procedures, Early warning Systems Models in disaster preparedness, Components of Disaster Relief, Community based DRR, Public Awareness and Warnings, Conducting a participatory capacity and vulnerability analysis, DRR Master Planning for the Future, Capacity Building, Rehabilitation measures and long term reconstruction.	8	CO2
3	Principles of Disaster Medical Management	Introduction to disaster medicine, Various definitions in disaster medicine, Disaster recovery in relation to disaster medical management, National Assessing the nature of hazardous material - Types of injuries caused, Self-protection contaminated area and decontaminated area – Pre hospital medical management of victims – Triaging medical & psychosocial identification of hospitals and other medical facilities to offer efficient disastrous medical service – Safe patient transportation –Identification of valuable groups.	8	CO4
4	Public Health Response and International	Principles of Disaster Epidemiology, Rapid Health Assessment, Outbreak Investigation Environment health hygiene and sanitation issues during disasters, Preventive and prophylactic measures, International cooperation in funding on public health during disaster, International Health Regulation, United Nation International Strategy for Disaster Risk Reduction, United Nation Disaster Management Team, International Search and Rescue Advisory Group.	8	CO3
5	Disaster Risk Management in India	Hazard and Vulnerability profile of India, Disaster Management Indian scenario, Disaster Management Act 2005 and Policy guidelines, National Institute of Disaster Management, National Disaster Response Force, National Disaster Management Authority, States Disaster Management Authority, District Disaster Management Authority. Cases Studies like Bhopal Gas Disaster, Gujarat Earth Quake, Orissa Super-cyclone, South India Tsunami e.t.c, best practices in disaster management, Appropriate Technology and local Responses, Indigenous Knowledge, Development projects in India and their impacts, Logistics management in specific emergency situation.	8	CO3

Reference Books:

- 1.Natural Disasters – A Guide for relief workers– JAC Adhyatme Sadhma Kendra, Mehrauli, N. Delhi.
- 2.Parasuraman S and Unnikrishnan PV (2000) Indian Disasters – Report towards a policy initiative, Oxford University Press,UK.
- 3.Petalc WJ and Allissoon AA (1982) Natural Hazards Risk Assessment and Public Policy Anticipating Unexpected, Springer-Verlag, New York.
- 3.Shailendra K. Singh, Subash C, Kundu and Shobu Singh (1998) Disaster Management, Mittal Publications, New Delhi.

e-Learning Source:

- 1.https://www.youtube.com/watch?v=9Wlwljva_s
- 2.https://www.youtube.com/watch?v=uA_OLKfQpYA

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

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

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

Name & Sign of Program Coordinator	Sign & Seal of HoD
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Effective from Session: 2017-2018							
Course Code	ES408	Title of the Course	Environmental Toxicology	L	T	P	C
Year	I	Semester	II	3	1	0	4
Pre-Requisite	Environmental Chemistry	Co-requisite					
Course Objectives	1. To have a basic knowledge of toxicology. 2. To have knowledge of methods and data used for testing of toxicity. 3. To provide knowledge of pesticide toxicology. 4. To have knowledge of concept of bioassay. 5. To develop knowledge of xenobiotic compounds.						

Course Outcomes	
CO1	Have an enhanced knowledge of Toxicology.
CO2	Be able to make connections and interrelations between data used for toxicity testing.
CO3	Be able to explain toxicity caused by pesticides in human body and their environment.
CO4	Be able to explain bioassay and related problems.
CO5	Be able to describe xenobiotic compounds.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	Toxicology - Introduction, scope and types - Classification of toxic agents, toxicity, hazard, risk, Routes of exposure, duration and frequency of exposure - Drug toxicity, biochemical basis of toxicity and mechanisms of toxicity, receptor mediated events - Acute and chronic toxicity, Dose response relationship and graded response time action curves, LC50 LD50, Margin of safety levels.	8	CO1
2	Toxicity testing	Toxicity testing – (i) laboratory animals, (ii) toxicity testing in animals, (iii) toxicological field studies, Interpretation of laboratory data (i) distinction between adverse and non-adverse effects. Human data – (i) ethical consideration, (ii) need for human investigation (iii) clinical toxicology.	8	CO2
3	Pesticide toxicology	Bioaccumulation and Bio magnifications of toxic materials in food chain, Types, mechanism and Toxicology of major pesticides - Environmental impacts of pesticides, biotransformation, monitoring, concept of bio-indicator groups and examples.	8	CO3
4	Bioassay	Concepts of Bioassay, Types and characteristics - Field based microbial bioassay, Test models and classification - Immunotoxicity, histotoxicity and cell toxicity. Basic concepts of Environmental forensics.	8	CO4
5	Xenobiotics	Xenobiotics, Interaction between xenobiotics, Combined effect of xenobiotics on physiology and biochemistry of aquatic organisms - Drug Development and safety, Drugs and chemicals induced hepatotoxicity, food toxicity, genotoxicity, Molecular neurotoxicity.	8	CO5

Reference Books:

1-Anisa Basheer (1995) Environmental Epidemiology, Rawat Publications, New Delhi.

2-Meera Asthana and Astana D.K (1990) Environmental Pollution and Toxicology, Alka Printers, Chandigarh.

3-Sharma PD, Rastogi and Lamporary (1994) Environmental Biology and Toxicology, Rajpal and Sons Publishing, New Delhi.

4-Sood A (1999) Toxicology, Sarup and Sons, New Delhi. Toxicology, Biochemistry and Pathology of Mycotoxins, by Kenji Uroguchi a mikio, Yamazadi Kodanshoa Ltd., Tokyo, 1978.

e-Learning Source:

https://www.youtube.com/results?search_query=Environmental+Toxicology

<https://www.youtube.com/watch?v=RNNjN065y5o>

<https://www.youtube.com/watch?v=v4jmPpTcdxQ>

<https://www.youtube.com/watch?v=-u3sHVjd-So>

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

Effective from Session: 2017-18							
Course Code	ES409	Title of the Course	Ecotourism & Wildlife Management	L	T	P	C
Year	M.Sc. 1 st Year	Semester	II (Odd-Sem)	3	1	0	
Pre-Requisite	Natural Resource	Co-requisite					
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 concept of bioassay. To develop knowledge of Wildlife Management.						

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

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

Reference Books:	
1-Dasman RF (1968) Environmental Conservation: John Wiley and Sons, New York.	
2-Mukherjee N (2008) Ecotourism and sustainable Development. Cybetech Publications, New Delhi.	
3-Prabhas Chandra (2003) Global Ecotourism, Kanishka Publishers, New Delhi.	
4-Sinha, P.C (2003) Encyclopedia of Ecotourism, Volume I, II and III, Anmol Publications Pvt. Ltd., New Delhi.	
5-Weaver DB (2001) The Encyclopedia of Ecotourism, CABI Publishing, UK.	
e-Learning Source:	
https://www.slideshare.net/chandikechelamalpe/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	

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

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

Effective from Session: 2017-2018							
Course Code	ES410	Title of the Course	Environmental Pollution and Management	L	T	P	C
Year	I	Semester	II	3	1	0	4
Pre-Requisite	Environmental Chemistry	Co-requisite					
Course Objectives	1.It will enable students to understand environmental problems, looking at causal linkages between pollution sources, exposure pathways and impacts to environmental quality and human health. 2.Students will identify the complex relationships between environmental factors and human health, taking into account multiple pathways and interactions, will be assessed in a broader spatial, socioeconomic and cultural context. 3.Students will learn how to assess pollution sources, study exposure pathways and fate, and evaluate consequences of human exposure to pollution and its impacts to environmental quality. 4.Providing the evidence base to support decision and policy making, students should be able to understand pollution problems, consider ways to respond to them, and propose appropriate solutions/actions to reduce (protect, mitigate or prevent) pollution risks when necessary.						

Course Outcomes	
CO1	Have gained awareness of current forms of environmental pollution and an overview of both their causes and consequences to natural, economic and social systems.
CO2	Students understands the fundamental principles governing the interactions between those systems (i.e. transport of pollutants in the environment)
CO3	Have been exposed to learning examples of good practice of technologies and options used to remediate reduce/eliminate pollution of the environment
CO4	Be able to analyse, synthesise, and evaluate evidence to understand problems and accordingly select control measures and techniques concerning atmospheric, water or terrestrial challenges.
CO5	Students will be able to identify mitigation measures, air treatment techniques, waste water treatment, wastes treatment, soil remediation

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Air Pollution and Management	Air Pollution- Natural and Anthropogenic Sources- Major Air Pollutants - Types and effects of Air Pollutants-Acid Rain , Green house effect and global Warming- Meteorology and Plume dispersion-Sampling of Air Pollutants- Sox, Nox, Ozone, methane, Hydrocarbons and Particulate Matter. Particulate Matter Control Equipments: Settling chamber, Cyclone, Fabric filter, electrostatic Precipitator and Wet Scrubbers- Air quality and emission standards.	8	CO1
2	Water Pollution and Management	Water Pollution-sources of water pollution-organic, inorganic and heavy metals- Phenomena of Eutrophication-Transport of Pollutants in the aquatic Ecosystem-Water quality Parameters- Water quality standards- sources, effects and control measures ocean, oil and ground water pollution- Water Sampling techniques- Water remediation techniques: Rhizofiltration, wetlands, lagoons, oxidation pond and oxidation ditch.	8	CO2
3	Water Treatment Methods and Strategies	Water treatment: Drinking water and waste water treatment technologies- physical chemical and biological-Primary , secondary and tertiary treatments- sludge dewatering and its disposal. Designs and functioning of ETP; Concept of ETP, Need of ETP ion Industry, Concept of CETP, Major units in ETP and their functions- Water Management strategies: Rain water harvesting, Recharging of ground water, Use of Domestic waste water , recycling of waste water, recycling of industrial effluent after treatment.	8	CO3
4	Soil Pollution and Management	Soil pollution: Sources- Industrial, Domestic, Agricultural (Pesticides, heavy metals, industrial effluents, waste disposal) - Effects of soil pollutants on plants, animals and ground water - Soil sampling devices, methods and analysis-Soil remediation techniques: Physical, chemical and biological (bioremediation and phytoremediation).	8	CO4
5	Noise and Radioactive Pollution and Management	Noise Pollution: Sources, sound pressure levels, decibels, intensity and duration - Effects of noise pollution on human and animals - Noise permissible standards - Noise control measures - greenbelt and noise protective instruments - 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	
3-Saxena HM (2011) Environmental Geography	
4-Rao CS (1993) Environmental Pollution Control	
e-Learning Source:	
https://www.britannica.com/science/pollution-environment	
https://www.who.int/health-topics/air-pollution	

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

Effective from Session: 2022-2023

Course Code	ES411	Title of the Course	Natural Resource Management Lab	L	T	P	C
Year	I	Semester	II	0	0	8	4
Pre-Requisite	Natural Resource	Co-requisite					
Course Objectives	To know the analysis of Dissolved Oxygen (DO), Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) in the given Sample. To understand the analysis of Na, K, Ca and Mg by Flame photometer, To understand and analysis of SOx and NOx. To understand estimation of particle size distribution of the soil. To know how to determine the specific gravity and moisture content of the soil.						

Course Outcomes	
CO1	The analysis of Dissolved Oxygen (DO), Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) in the given Sample and its importance.
CO2	The analysis of Na, K, Ca and Mg by Flame photometer.
CO3	The analysis of SOx and NOx of particular area and its effects on the environment.
CO4	The estimation of particle size distribution of the soil.
CO5	The determination of the specific gravity and moisture content of the soil.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Water Parameters	Estimation of Dissolved Oxygen and Biological oxygen Demand Estimation of Chemical oxygen demand	8	CO1
2	Minerals Estimation	Flame Photometric analysis of Na, K, & Ca & Mg Phosphate estimation	8	CO2
3	Air Parameters	Sampling and Analysis of SOx and NOx Determination of noise levels at various sites	8	CO3
4	Soil Parameter	The estimation of particle size distribution of the soil.	8	CO4
5	Soil Parameter	The determination of the specific gravity and moisture content of the soil.	8	CO5

Reference Books:

- 1-Handbook of Drinking water Quality by John Dezuane, John Wiley & Sons
- 2-The Environmental Science of Drinking Water Patrick Sullivan, Franklin J. Agardy, James J.J. Clark

e-Learning Source:

Quality of Water | Physical Parameters | Lecture 6 | Environmental Engineering - YouTube

<https://www.youtube.com/watch?v=m9XGsEs55Qo>

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

<https://www.youtube.com/watch?v=w5RKH9V6g>

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

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

Name & Sign of Program Coordinator	Sign & Seal of HoD
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