

## CO-PO mapped syllabi of M.Sc. Environmental Sciences (For new students, w.e.f. 2020-21)

### Program Educational Objective (PEOs): M.Sc. Environmental Science:

- To impart students with strong knowledge base through theory courses and sessional that makes them suitable for industries, academics, research and consultancies.
- To develop students analytical, computational and research skills through assignments, weekly presentations and modeling software.
- To train the students on developing practical, efficient and cost effective solutions on problems and challenges on environmental sciences and engineering.
- To inculcate among students sensitivity towards social and corporate responsibilities

### Programme Specific Outcomes (PSOs):

- Apply the basic concepts of physical, chemical, mathematical, and biological sciences appropriately to the discipline of environmental science.
- Use state-of-the-art techniques, tools and skills necessary for accurate analysis of environmental samples.
- Demonstrate knowledge and understanding of the environmental principles and apply these to his own work, as member and/or leader in a team, to execute multidisciplinary projects.

### POs for PG programs: M.Sc Environmental Science

<b>Program Outcomes (POs)</b>	<ol style="list-style-type: none"><li>1. <b>Critical thinking:</b> In depth knowledge of basic and applied area of Environmental Science. Capability to demonstrate knowledge and understanding of major concepts of Environmental Science. Ability to use modern instrumentation techniques to employ critical thinking and efficient problem solving skills in the basic areas of Environmental Science.</li><li>2. <b>Effective Communication-</b> Excellent communication skills to transmit complex technical information related to Environmental Science in a clear and concise written and verbal manner as oral presentations and compilation in the form of scientific reports.</li><li>3. <b>Social Interaction-</b> Comprehend to apply contextual multi-disciplinary knowledge to assess societal, health, safety, and cultural issues relevant to the science practices.</li><li>4. <b>Effective Citizenship-</b> Imbibe moral and social values in personal and social life leading to highly cultured and civilized personality.</li><li>5. <b>Ethics-:</b> Students will be able to recognize the ethical component of complex situations. Acquired with awareness of work ethics and ethical issues in scientific research as well as plagiarism policies.</li><li>6. <b>Research related skills:</b> Develop ability to adopt changing scientific environment in the process of sustainable development by using statistical tools.</li></ol>
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	<p>7. <b>Environment and Sustainability-</b> Advanced knowledge of fundamentals of Environmental Science with enhanced command over modern scientific methods, techniques and chemical processes equipped with environment safety measures.</p> <p>8. <b>Self-directed and Lifelong learning-</b> Students will be capable of self-paced and self-directed learning aimed at personal development and for improving knowledge/skill development. They will keep themselves updated with the best international practices and latest development in technologies, which will help them to gain a broader global perspective of the subject. Develop awareness of the role and importance of Environmental Science in interdisciplinary research as well as in daily life.</p>
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**Course: Advanced studies in Environment and**

**Ecology Course Code: ES401**

**Course Objectives:**

- Understand how interactions between organisms and their environments drive the dynamics of individuals, populations, communities, and ecosystems
- Recognize the ecological basis for regional and global environmental issues
- Understand the processes and patterns of evolution, and the role of evolution as the central unifying concept in environmental science
- Understand the Importance and also the techniques to protect natural Resources

**Course Outcomes (CO):**

Course Outcome(Co)	Description
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.

CO-PO mapping for a course of “ PG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Develop empathy for various life forms and appreciate the various ecological linkages within the web of life.	3	1	2	2	1	2	3

<b>CO2</b>	Apply the scientific method and quantitative techniques to describe, monitor and understand environmental systems.	<b>3</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>3</b>
<b>CO3</b>	Use interdisciplinary approaches such as ecology, economics, ethics and policy to devise solutions to environmental problems.	<b>3</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>3</b>	<b>2</b>	<b>3</b>
<b>CO4</b>	Be proficient in ecological field methods such as wildlife survey, biodiversity assessment, mathematical modeling and monitoring of ecological systems.	<b>3</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>3</b>
<b>CO5</b>	Explain the process and philosophical basis of scientific inquiry.	<b>3</b>	<b>1</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>3</b>

**Course: Energy and Green Technologies Course Code: ES402**

**Course Objectives:**

- To present different concepts of green technologies.
- To acquire principles of Energy efficient technologies.
- To impart knowledge on the methods of reducing CO2 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 (CO):**

<b>Course Outcome(Co)</b>	<b>Description</b>
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 CO2 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

**CO-PO mapping for a course of “UG program”**

<b>S.No.</b>	<b>CO description</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>
<b>CO1</b>	Students are able to understand different concepts of green technologies.	<b>3</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>3</b>
<b>CO2</b>	Students are able to understand acquire principles of Energy efficient technologies.	<b>3</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>
<b>CO3</b>	Students are able to understand impart	<b>3</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>

	knowledge on the methods of reducing CO <sub>2</sub> levels in atmosphere							
<b>CO4</b>	Students are able to understand learn the importance of green fuels and its impact on environment.	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>
<b>CO5</b>	Students are able to understand basic actions to prevent degradation of the environment and harmful effects on humans	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>3</b>

**Course: Basics of Environmental Microbiology Course Code: ES403**

**Course Objectives:**

1. To know about historical events in microbiology, structural detail of prokaryotic and eukaryotic cell.
2. To understand microbial growth, multiplication and sterilization techniques.
3. Role of microbes in nutrient cycling.
4. Study of different microbial interaction and importance of Soil micro flora.
5. To assess impact of microbes on quality of air and water.
6. Uses of microbes for degradation of waste material

**Course Outcomes (CO):**

On completion of the course, students are able to:

<b>Course Outcome (CO)</b>	<b>Description</b>
CO1	Get an idea about the historical events in microbiology
CO2	Understand concepts of growth and reproduction of bacteria • Know anatomy of prokaryotic cell • Know structural detail of cells • Understood various parts of cell and its importance.
CO3	Know concepts related with of microbial interaction • Get an idea regarding microbes and their relation with environment.
CO4	Students will get basic knowledge to determine the role of microbes: <ol style="list-style-type: none"> <li>a. in different habitats,</li> <li>b. in different biogeochemical cycles,</li> <li>c. to determine water quality,</li> <li>d. in degradation of natural organic compounds and selected pollutants in the environment.</li> </ol>
CO5	The knowledge can be used to prevent infections and to protect human and environmental health.

CO-PO mapping for a course of “ PG program”								
S.No	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	On completion of the course, students are able to get an idea about the historical events in microbiology.	2	1	2	2	2	1	2
CO2	Understand concepts of growth and reproduction of bacteria • Know anatomy of prokaryotic cell • Know structural detail of cells • Understood various parts of cell and its importance.	2	1	1	1	1	2	2
CO3	Know concepts related with of microbial interaction. Gets an idea regarding microbes and their relation with environment.	2	1	2	2	1	2	2
CO4	Students will get basic knowledge to determine the role of microbes: a. in different habitats, b. in different biogeochemical cycles, c. to determine water quality, d. in degradation of natural organic compounds and selected pollutants in the environment.	2	1	2	1	1	2	2
CO5	The knowledge can be used to prevent infections and to protect human and environmental health.	2	1	3	1	2	1	1

<b>1. Name of the Department: Environmental Science</b>						
<b>2. Course Name</b>	<b>Climate Change and Current Issues</b>			<b>L</b>	<b>T</b>	<b>P</b>
<b>3. Course Code</b>	<b>ES 404</b>			3	1	0
<b>4. Type of Course (use tick mark)</b>		<b>Core</b> ( <input type="checkbox"/> )	<b>DSE</b> ( )	<b>AEC</b> ( )	<b>SEC</b> ( )	<b>OE</b> ( )
<b>5. Pre-requisite (if any)</b>	B.Sc./B.Sc. (Hons.) with Biological Science (Zoology, Botany, Chemistry)/Life Sciences/ Biotechnology/Microbiology /	<b>6. Frequency (use tick marks)</b>	Even ( )	Odd ( <input type="checkbox"/> )	Either Sem ( )	Every Sem ( )
<b>7. Total Number of Lectures, Tutorials, Practicals</b>						
<b>Lectures = 30</b>		<b>Tutorials = 10</b>		<b>Practical = Nil</b>		
<b>8. COURSE OBJECTIVES:</b> The purpose of this undergraduate 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.						
<b>9. COURSE OUTCOMES (CO):</b> <i>r the successful course completion, learners will develop following attributes:</i>						
<b>COURSE OUTCOME</b>		<b>ATTRIBUTES</b>				



	3 Strong contribution, 2 Average contribution , 1 Low contribution
	<b>12. Brief description of self learning / E-learning component</b>
	1. <a href="https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/119106008/lec40.pdf">https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/119106008/lec40.pdf</a> 2. <a href="http://www.fao.org/3/CA2607EN/ca2607en.pdf">http://www.fao.org/3/CA2607EN/ca2607en.pdf</a> 3. <a href="http://moef.gov.in/wp-content/uploads/2019/08/Annual-Report-2018-19-English.pdf">http://moef.gov.in/wp-content/uploads/2019/08/Annual-Report-2018-19-English.pdf</a>
	<b>13. Books recommended:</b> 1. Barrie Pittock A (2009) Climate Change: The Science, Impacts, and Solutions,CSIRO,Australia. 2. Botkin DB (1989) Changing the Global Environment, Academic Press, USA. 3. Cowie J (2007) Climate Change: Biological and Human Aspects, Cambridge University Press, UK. 4. Dogra N Srivastava S (2012) Climate Change & Disease Dynamics in India, TERI, New Delhi. 5. Filho WL (2012), Climate Change and Sustainable Use of Water Resources, Springer Verlang, Berlin, HiedelBerg.

### Environmental Ecology Lab, Subject Code: ES-405

#### List of Experiments

1. Lab rules and regulations. Glassware maintenance, sterilization and Disinfection techniques.
2. Examination of Prokaryotic and Eukaryotic cells.
3. Estimation of BOD, COD, DO for given water samples.
4. Determination of minimum quadrat size for community study.
5. Estimation of pH and conductivity.
6. Estimation of Total Suspended Solids & Total Dissolved Solids.
7. General instructions, Microbiology laboratory and its discipline.
8. Handling of microscopes, Calibration and measurement of microscopic objects.
9. Enumeration of bacteria from soil samples.
10. Enumeration of fungi from soil samples.
11. Isolation of Rhizobium from nodules.
12. Estimation of chlorophyll.

#### Objectives:

- To Study about laboratory rules, regulation and handling of microscopes.
- To Study about various water quality parameters.
- To Study about microbes in soil samples
- To determine quadrat size for community study
- To Estimate chlorophyll content in a given sample.

#### Course Outcomes (CO):

Course Outcome(Co)	Description
CO1	Develop in depth knowledge about laboratory rules, regulation and handling of microscopes.

CO2	Gain knowledge about assessment of various water quality parameters.
CO3	Learn about soil microbiology and its significance.
CO4	Learn about importance of quadrat size calculation for community study
CO5	Analyze chlorophyll content estimation in a given sample.

CO-PO mapping								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Develop in depth knowledge about laboratory rules, regulation and handling of microscopes.	3	2	2	1	1	3	3
CO2	Gain knowledge about assessment of various water quality parameters.	3	2	2	1	1	3	3
CO3	Learn about soil microbiology and its significance.	3	2	2	1	1	3	3
CO4	Learn about importance of quadrat size calculation for community study	3	2	2	1	1	3	3
CO5	Analyze chlorophyll content estimation in a given sample.	3	2	3	1	1	3	3

**Course:** Natural Resources and Management

**Course Code:** ES406

**COURSE OBJECTIVES:**

- To have a basic knowledge of Natural resources its classification, concepts and natural resources of India.
- Determine the role played by agricultural practices in soil degradation - Soil erosion – Soil Fertility and Nutrient Management: Organic Farming: Green manuring.
- To understand systematic exploration of mineral deposits, development and conservation of minerals.
- To promote conditions for environmentally sustainable, economically efficient and equitably allocated use of water resources.
- To ensure long-term forest productivity and conservation of forest resources through prompt reforestation, soil conservation, afforestation, and other measures.



**COURSE OUTCOMES (CO):***After completion of the course, a student will be able to*

Course Outcome(Co)	Description
CO1	Students will be able to introduced and aware from different types resources and its distribution.
CO2	Students will be able to Analyse contributions soil resources and how soil quality get affected by different events.
CO3	Create a knowledge for sustainable exploration and 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.

**CO-PO mapping for a course of “ PG program”**

S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Students will be able to introduced and aware from different types resources and its distribution.	3	1	1	1	2	2	2
CO2	Students will be able to Analyse contributions soil resources and how soil quality get affected by different events.	2	1	2	1	2	2	2
CO3	Create knowledge for sustainable exploration and use and conservation of different types of mineral resources.	3	1	2	1	2	2	2
CO4	Students will be able to know about importance of water resources, Remedial Measures in conserving water resources.	3	1	2	2	2	2	2
CO5	The knowledge can be used to prevent deforestation and long-term measures for productivity and conservation of forest resources.	3	1	2	2	2	2	2

**Course: Disaster, Mitigation and Management****Course Code: ES407****Course Objectives:** □

- To provide basic concept about Hazard and Natural Disaster.
- To develop basic knowledge about Disaster Risk Reduction.
- To provide knowledge about 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 (CO):**

Course Outcome(Co)	Description
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CO1	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 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.

CO-PO mapping for a course of “ PG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Be able to learn Economic impact of Disaster Relationship between Disaster and Development	3	2	3	2	3	3	2
CO2	Student will be able to learn role of disaster medicine during natural manmade Disaster	3	2	3	3	3	3	3
CO3	Student will be able to learn Disaster Risk Reduction Master Planning for Sustainable development	3	3	2	2	3	2	3
CO4	Be able to learn Disaster Epidemiology Environment health hygiene during disaster.	3	2	2	3	3	2	3
CO5	Student will be able to learn Role of National Institute of Disaster Management and Disaster Response Force during Disaster.	3	3	3	3	3	3	3

**Course: Environmental Toxicology**

**Course Code: ES408**

**COURSE OBJECTIVES:**

- To have a basic knowledge of toxicology.
- To have knowledge of methods and data used for testing of toxicity.
- To provide knowledge of pesticide toxicology.
- To have knowledge of concept of bioassay.
- To develop knowledge of xenobiotic compounds.

**COURSE OUTCOMES (CO):***After completion of the course, a student will be able to*

Course Outcome(Co)	Description
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 biassay and related problems.
CO5	Be able to describe xenobiotic compounds.

CO-PO mapping for a course of “UG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Have an enhanced knowledge of Toxicology.	2	2	2	2	2	1	1
CO2	Be able to make connections and interrelations between data used for toxicity testing.	3	2	1	1	2	1	1
CO3	Be able to explain toxicity caused by pesticides in human body and their environment .	2	2	2	2	2	1	1
CO4	Be able to explain biassay and related problems.	1	2	1	1	2	1	1
CO5	Be able to describe xenobiotic compounds.	2	2	1	2	2	1	1

**Course: Environmental Pollution and Management****Course Code: ES410****Course Objectives:**

- 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.
- 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, socio-economic and cultural context.
- 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. 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 (CO):**

At the end of the course students should:

<b>Course Outcome(CO)</b>	<b>Description</b>
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

<b>CO-PO mapping for a course of “ PG program”</b>								
<b>S.No.</b>	<b>CO description</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>
<b>CO1</b>	Have gained awareness of current forms of environmental pollution and an overview of both their causes and consequences to natural, economic and social systems.	<b>3</b>	<b>1</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>
<b>CO2</b>	Students understands the fundamental principles governing the interactions between those systems (i.e. transport of pollutants in the environment)	<b>3</b>	<b>1</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>CO3</b>	Have been exposed to learning examples of good practice of technologies and options used to remediate reduce/eliminate pollution of the environment,	<b>3</b>	<b>1</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>
<b>CO4</b>	To impart students with strong knowledge base through theory courses and sessional that makes them suitable for industries, academics, research	<b>3</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>
<b>CO5</b>	Students will be able to identify mitigation measures, air treatment techniques, waste water treatment, wastes treatment, soil remediation	<b>3</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>3</b>

**Course:** Natural Resource Management Lab  
**Course Code:** ES411

**List of Experiments**

- Estimation of Dissolved Oxygen and Biological oxygen Demand.
- Estimation of Chemical oxygen demand.
- Flame Photometric analysis of Na, K, & Ca & Mg. Phosphate estimation.
- Sampling and Analysis of SO<sub>2</sub> and NO<sub>X</sub>.
- Determination of noise levels at various sites
- Estimation of particle size distribution of the soil.
- Determination of Specific gravity and moisture content of the soil.
- Study Tour

**Course Objectives:**

1. To understand about Dissolved Oxygen, Biological oxygen Demand and Chemical oxygen demand..
2. To understand about Flame Photometric analysis of Na, K, & Ca, Mg & Phosphate estimation .
3. To understand about sampling and Analysis of SO<sub>2</sub> and NO<sub>X</sub>.
4. To understand about determination of noise levels at various sites.
5. To understand about soil characteristics.

**Course Outcomes (CO):**

<b>Course Outcome(Co)</b>	<b>Description</b>
CO1	To estimate Dissolved Oxygen, Biological oxygen Demand and Chemical oxygen demand.
CO2	To analyze Flame Photometric analysis of Na, K, & Ca, Mg & Phosphate estimation .
CO3	To gain hands on experience of sampling and analysis of SO <sub>2</sub> and NO <sub>X</sub> .
CO4	To determine noise levels at various sites.
CO5	To analyze and estimate about soil characteristics.

CO-PO mapping								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	To estimate Dissolved Oxygen, Biological oxygen Demand and Chemical oxygen demand.	3	2	2	1	1	3	3
CO2	To analyze Flame Photometric analysis of Na, K, & Ca, Mg & Phosphate estimation .	3	2	2	1	1	3	3
CO3	To gain hands on experience of sampling and analysis of SO2 and NOX.	3	2	2	1	1	3	3
CO4	To determine noise levels at various sites.	3	2	2	1	1	3	3
CO5	To analyze and estimate about soil characteristics.	3	2	3	1	1	3	3

**Course: Biodiversity Monitoring and Management Course Code: ES501**

**Course Objectives:**

1. To understand fundamentals of variations amongst living world
2. To Assess Biological Resources and benefits arises from its
3. Identification of threats to biodiversity
4. To understand the importance of natural resources and Sustainable Management of Bio-resources
5. To conserve Biological Resources by implementing Policies, Programs and Acts

**Course Outcomes (CO):**

Course Outcome (CO)	Description
CO1	Articulate the goals of conservation biology, that is, to maintain biological diversity in all its expressions
CO2	Able to understand concept of biodiversity and its key component, concepts of taxonomy, ecology, genetics, geography, and evolution.
CO3	Explain why biological diversity is important, that is, nature's intrinsic and instrumental values
CO4	Highlight the threats to biological diversity, that is, direct harvesting, habitat destruction, and introduction of non-native species, among others, and their interactions.

CO5	Able to specify context appropriate actions needed to protect and restore biological diversity, that is, endangered species recovery, methods, quantitative assessment and data analysis, familiarity with relevant policy, law and government at local, regional, national and international levels.
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CO-PO mapping for a course of “ PG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	articulate the goals of conservation biology, that is, to maintain biological diversity in all its expressions. Able to specify context appropriate actions needed to protect and restore biological diversity.	2	1	1	2	3	1	1
CO2	able to understand concept of biodiversity and its key component, concepts of taxonomy, ecology, genetics, geography, and evolution.	3	1	2	1	1	1	2
CO3	explain why biological diversity is important, that is, nature’s intrinsic and instrumental values.	2	1	2	3	3	2	2
CO4	highlight the threats to biological diversity, that is, direct harvesting, habitat destruction, and introduction of non-native species, among others, and their interactions.	2	2	2	2	3	2	1
CO5	apply management strategies for conservation of biodiversity. Able to specify context appropriate actions needed to protect and restore biological diversity, that is, endangered species recovery, designating ecological reserves, ecosystem restoration, invasive species management, interfacing with in the policy-making process, educating others, and combinations thereof.	2	2	2	2	2	3	3

**Course: Environmental**

**Laws Course Code:**

**ES502**

**Course Objectives:**

- To study Environmental laws in India.
- To study the guidelines and rules for Environmental Protection.
- To study the importance of Environmental planning.
- To study major initiatives and policies from Ministry of Environment and Forests

□

**Course Outcomes (CO):**

Course Outcome(Co)	Description
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CO1	To understand how to protect the environment as it provides a guideline so that we can take care of the environment in an effective manner.
CO2	To understand how people can use natural resources on what terms.
CO3	Environmental laws are also in the front line to make sure that the law is followed when it comes to taking care of an environment.
CO4	This subject provides a platform to understand main function is the protection of human health as well as the environment.
CO5	To understand that the process of waste management does not interfere with the environment or human health.
CO6	To understand that industries meet all the legal obligations that is required to run them.

CO-PO mapping for a course of “ UG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1		3	2	2		2	1	
CO2		3	1	1		2	1	
CO3		3	2	1		2	1	
CO4		3	2	1		1	2	
CO5		3	1	1		2	1	

**Course: Waste Resources Management**

**Code: ES503**

**Course Objectives:**

- To bring the basic introduction about the waste among the students and its global scenario at national level.
- To enable students to know about the municipal solid waste and its various disposable methods and techniques.
- To develop clear thinking about hazardous and radioactive pollution and its advanced develop technology to control and manage this type of pollution.
- To develop attitude towards the issues arising from the biomedical and plastic pollution and its control methods at national and international levels.
- To create awareness programme among students about safe, clean and renewable technology.

Course Outcome(Co)	Description
CO1	To bring the basic introduction about the waste among the students and its global scenario at national level.



CO2	To enable students to know about the municipal solid waste and its various disposable methods and techniques.
CO3	To develop clear thinking about hazardous and radioactive pollution and its advanced develop technology to control and manage this type of pollution.
CO4	To develop attitude towards the issues arising from the biomedical and plastic pollution and its control methods at national and international levels.
CO5	To create awareness programme among students about safe, clean and renewable technology

CO-PO mapping for a course of “ PG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	To bring the basic introduction about the waste among the students and its global scenario at national level.	3	2	2	3	3	2	2
CO2	To enable students to know about the municipal solid waste and its various disposable methods and techniques.	3	1	2	2	2	3	3
CO3	To develop clear thinking about hazardous and radioactive pollution and its advanced develop technology to control and manage this type of pollution.	2	3	3	3	3	3	3
CO4	To develop attitude towards the issues arising from the biomedical and plastic pollution and its control methods at national and international levels.	3	2	3	3	3	3	3
CO5	To create awareness programme among students about safe, clean and renewable technology.	2	2	3	2	2	3	2

**Course: Remote Sensing and GIS**  
**Course Code: ES504**

**Objectives:**

- To develop the scientific knowledge about Remote Sensing and its application.
- To develop attitude towards the fundamental education of Satellite Remote Sensing.
- To develop clear thinking about the application of GIS in forest and environment among students.
- To develop attitude towards fundamental concept of GIS in environment management.
- To provide the rational and scientific thinking about the basics of Maps,

Scales and Cartography.

**Course Outcomes (CO):**

Course Outcome(Co)	Description
CO1	The mapping and development of a database using GPS and GIS technologies in experimental studies.
CO2	Be able the students to develop attitude towards the fundamental education of Satellite Remote Sensing.
CO3	The development of state-of-the-art methodologies for optimizing the water supply networks, both in the design and in the operation phase, using multiple variables and criteria.
CO4	The detailed experimental verification of the computational results and the development of know-how for self-regulation of pumps and valves in order to satisfy the supply needs in conjunction with the uniform pressure distribution in the water supply network.
CO5	The development of guidelines which could form the basis for Snow modeling.

**CO-PO mapping for a course of “ PG program”**

S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	The mapping and development of a database using GPS and GIS technologies in experimental studies.	2	2	2	1	2	1	2
CO2	The students develop attitude towards the fundamental education of advanced and modern Satellite Remote Sensing.	3	1	1	1	2	1	3
CO3	The development of state-of-the-art methodologies for optimizing the water supply networks, both in the design and in the operation phase, using multiple variables and criteria.	3	2	1	1	2	1	2
CO4	The detailed experimental verification of the computational results and the development of know-how for self-regulation of pumps and valves in order to satisfy the supply needs in conjunction with the uniform pressure distribution in the water supply network.	3	2	1	1	1	2	2
CO5	The development of guidelines which could form the basis for Snow modeling.	3	1	1	2	2	1	2

**1. Name of the Department: Environmental Science**

<b>2. Course Name</b>	<b>Environmental Impact Assessment</b>		<b>L</b>	<b>T</b>	<b>P</b>
<b>3. Course Code</b>	<b>ES 506</b>		3	1	0
<b>4. Type of Course (use tick mark)</b>	<b>Core ()</b>	<b>DSE</b>	<b>AEC ()</b>	<b>SEC ()</b>	<b>OE ()</b>

<b>5. Pre-requisite (if any)</b>	B.Sc./B.Sc. (Hons.) with Biological Science (Zoology, Botany, Chemistry)/Life Sciences/ Biotechnology/Microbiology /	<b>6. Frequency (use tick marks)</b>	Even (( <input type="checkbox"/> )		Odd)	Either Sem ( )	Every Sem ( )
<b>7. Total Number of Lectures, Tutorials, Practicals</b>							
<b>Lectures = 30</b>		<b>Tutorials = 10</b>		<b>Practical = Nil</b>			
<b>8. COURSE OBJECTIVES:</b> The purpose of this undergraduate course is to impart basic and key knowledge of Environmental Impact Assessment. This will help in enhancing knowledge of Environmental Impact Assessment legislations , Environmental clearance procedure for Projects, Environmental Impact Assessment methodologies, Environmental Auditing, monitoring and ISO standards and its certification process. After successfully completion of course, the student will able to explore subject into their respective dimensions.							
<b>9. COURSE OUTCOMES (CO):</b> <i>r the successful course completion, learners will develop following attributes:</i>							
<b>COURSE OUTCOME</b>		<b>ATTRIBUTES</b>					
<b>CO1</b>		Students will be able to Analyse role of Environmental Impact Assessment legislations in making decisions and getting Environmental clearance for Projects.					
<b>CO2</b>		Students will be able to Evaluate the role of Environmental Impact Assessment methodologies in Environmental Impact Assessment Process.					
<b>CO3</b>		Students will be able to Evaluate the Importance of ISO standards and its certification process in relation to environmental protection mechanism.					
<b>CO4</b>		Students will be able to Analyse role of Environmental Auditing and monitoring in Environmental Impact Assessment Process.					
<b>10. Unit wise detailed content</b>							
<b>Unit-1</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Introduction and Background</b>					
EIA, Relationship of EIA to sustainable development, scope and purpose of EIA; Key merits of environmental assessment in regulating the environment, Salient features of EIA legislation and other statutory obligations, Environmental decision making in India: Environmental clearance procedures and national requirements.							
<b>Unit-2</b>	<b>Number of lectures =08</b>	<b>Title of the unit: Assessment Framework</b>					
Methodological approaches and tools for key stages in EIA process: Screening (stage to determine the level of EIA, exclusion and inclusion criteria of projects, different approaches to screening) Scoping (scoping steps, guidance and tools, and stakeholder involvement), Impact prediction and evaluation (approach for baseline development and methods of impact identification-checklists, Matrices, Networks)							
<b>Unit-3</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Methods and Tools For EIA</b>					
Introduction to various impact assessment methods: checklist, matrices, networks, indices and weight scaling techniques; their scope and limitations, Prediction and assessment of impact on the land, air, water, noise, biological and socioeconomic environments Mitigation: definitions measures including avoidance, reduction, rectification and compensation approaches, principles and concepts of offsets, type of offsets.							
<b>Unit-4</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Environmental Auditing and Monitoring</b>					
Objectives and usefulness of Auditing, monitoring; EIA Types (monitoring, Baseline monitoring, Compliance monitoring; Mitigation monitoring), Ex ante and Post ante EIAs, introduction to national accreditation scheme, Requirement of EIA in India							
<b>Unit-5</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: ISO Standards</b>					

ISO 9001, historical background, benefits and clause analysis, EMS and its benefits, formulating environment policy, Clause analysis of ISO 14001, explanation of PDCA cycle, Training need identification, communication, audit process. Attributes of an auditor and psychology of auditing, audit reporting, certification process and certification bodies, legislation pertaining to ISO 14001 documentation preparation of L/R, emergency									
<b>11. CO-PO mapping</b>									
<b>Cos</b>	<b>Attributes</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
<b>CO1</b>	Students will be able to Analyse role of Environmental Impact Assessment legislations in making decisions and getting Environmental clearance for Projects.	3	1	2	1	1	2	2	3
<b>CO2</b>	Students will be able to Evaluate the role of Environmental Impact Assessment methodologies in Environmental Impact Assessment Process.	3	1	1	1	1	2	2	3
<b>CO3</b>	Students will be able to Evaluate the Importance of ISO standards and its certification process in relation to environmental protection mechanism.	3	1	1	1	1	2	2	3
<b>CO4</b>	Students will be able to Analyse role of Environmental Auditing and monitoring in Environmental Impact Assessment Process.	3	1	2	2	1	2	2	3
3 Strong contribution, 2 Average contribution , 1 Low contribution									
<b>12. Brief description of self learning / E-learning component</b>									
<ol style="list-style-type: none"> <li>1. <a href="http://www.fao.org/3/i2802e/i2802e.pdf">http://www.fao.org/3/i2802e/i2802e.pdf</a></li> <li>2. <a href="http://www.environmentwb.gov.in/pdf/EIA%20Notification,%202006.pdf">http://www.environmentwb.gov.in/pdf/EIA%20Notification,%202006.pdf</a></li> <li>3. <a href="http://extwprlegs1.fao.org/docs/pdf/ind4656.pdf">http://extwprlegs1.fao.org/docs/pdf/ind4656.pdf</a></li> <li>4. <a href="http://awsassets.wwfndia.org/downloads/session_13_1.pdf">http://awsassets.wwfndia.org/downloads/session_13_1.pdf</a></li> </ol>									
<b>13. Books recommended:</b>									
<ol style="list-style-type: none"> <li>1. Bregman JI (1999) Environmental Impact Statements. Lewis Publishers, London.</li> <li>2. Canter LW (1996) Environmental Impact Assessment. Mc Graw Hill, New York.</li> </ol>									

### **Biodiversity and Waste Management Lab, Subject Code: ES-505**

#### **List of Experiments:**

- Monitoring Flora and fauna and other Environmental Components.
- Analysis of soil microflora by dilution plate method, study of rhizospheric and rhizoplane microbes.
- Natural Resource Management assessment using Google Map, Remote Sensing and GIS.
- Vermi-composting. Experimental demonstration – Hands on Experience.
- Wetland field visit.
- Visit to waste dumping site.

#### **Objectives:**

- To understand about biodiversity, values and its significance.
- To understand about biodiversity conservation and its management.
- To understand about waste disposal techniques.
- To learn about waste dumping sites and its impact on environment.
  
- To understand about importance of natural resource management through remote sensing techniques

- To understand about monitoring of environmental components.

**Course Outcomes (CO):**

<b>Course Outcome(Co)</b>	<b>Description</b>
CO1	Develop in depth knowledge about environment, its components and monitoring of flora and fauna.
CO2	Apply the scientific knowledge in understanding about waste disposal techniques, dumping sites and about significance of wetland conservation.
CO3	Develop practical knowledge on study of rhizospheric and rhizoplane microbes and gain hands on experience on vermin composting.
CO4	Gain knowledge about natural resource management through use of remote sensing techniques.
CO5	Develop practical knowledge on analysis of soil micro flora

<b>CO-PO mapping</b>								
<b>S.No.</b>	<b>CO description</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>
<b>CO1</b>	Develop in depth knowledge about environment, its components and monitoring of flora and fauna.	<b>3</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>3</b>
<b>CO2</b>	Apply the scientific knowledge in understanding about waste disposal techniques, dumping sites and about significance of wetland conservation.	<b>3</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>3</b>
<b>CO3</b>	Develop practical knowledge on study of rhizospheric and rhizoplane microbes and gain hands on experience on vermin composting.	<b>3</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>3</b>
<b>CO4</b>	Gain knowledge about natural resource management through use of remote sensing techniques.	<b>3</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>3</b>
<b>CO5</b>	Develop practical knowledge on analysis of soil micro flora	<b>3</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>3</b>