

# 2021

## SYLLABUS OF POSTGRADUATE PROGRAMMES



SCHOOL OF ENVIRONMENTAL SCIENCES  
MAHATMA GANDHI UNIVERSITY



# **Mahatma Gandhi University**

## **School of Environmental Sciences**

### **Programmes:**

- 1. MSc. Environment Science and Management**
- 2. MSc. Environment Science and Disaster Management**

### **PROGRAMME SPECIFIC OUTCOMES (PSO)**

#### **MSc. ENVIRONMENT SCIENCE & MANAGEMENT**

1. To understand the basic concepts of environment and its interactions with the earth and environmental systems and various ecosystems associated with it.
2. Capability to analyse, evaluate and interpret the causes and effects of various environmental problems at local, regional and global scale and to develop management strategies.
3. Capacity to analyse and determine the magnitude of different kinds of environmental pollution, their sources using environmental analytical techniques, quantitative and computational techniques.
4. Acquire interdisciplinary knowledge on the global aspects of climate change, its effects on the environment and its governance
5. Capacity to use biotechnological methods in water and wastewater treatment technology. Ability to apply appropriate techniques for efficient solid waste management practices and to find the solutions to the air pollution problems.

6. Ability to use different tools for the management of energy resources, biodiversity conservation, natural disasters and technical knowhow of remote sensing & GIS applications in environment management.
7. Ability to analyse a given research problem, identify research gaps, developing suitable research methodology with suitable research design , data collection, data analysis with suitable statistical tool , interpretation of the findings leading to perfect solution to the problem given.
8. Demonstrate proficiency in quantitative methods, qualitative analysis, critical thinking, and written and oral communication needed to conduct high-level work as interdisciplinary scholars and/or practitioners.
9. Master the core concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
10. Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.

### **MSc. ENVIRONMENT SCIENCE & DISASTER MANAGEMENT**

1. To understand the basic concepts of environment, its interaction with the earth systems, and various ecosystems associated with it in relation to the disasters.
2. Enhance the capability to analyse, evaluate and interpret the causes and effects of various environmental problems in relation to disasters at local, regional and global scale and to develop management strategies.
3. Acquire basic knowledge, understanding and implementation of the International strategy on Disaster Reduction (UN-ISDR); to increase the skills and abilities for disaster risk reduction (DRR).
4. Acquire practical and research knowledge to build capacities that will reduce disaster risks and contribute to better relief measures.
5. Attain capacity to describe, analyse and evaluate the environmental, social, cultural, economic, legal and organisational aspects influencing vulnerabilities and capacities to face disasters.
6. Develop ability to work with theoretical and practical processes of disaster management (disaster risk reduction, response, and recovery) and relate their interconnections.

7. Enhance capacity to analyse, and communicate information on risks, relief needs and the lessons learned from past disasters in order to formulate mitigation strategies for the future scenarios; also to build clarity in presentation, discussion and in delivering the conclusions based on the knowledge and arguments.
8. Create ability to design and perform research on different aspects of emergencies and disaster events while demonstrating insights into the potential and limitations of science, its role in society and people's responsibility
9. Ability to coordinate community based disaster management strategies, in local and regional levels.
10. Demonstrate proficiency in quantitative methods, qualitative analysis, critical thinking, with written and oral communication skills needed for conducting high quality work as interdisciplinary scholars and/or practitioners.



**SCHEME OF THE SYLLABUS****MSc. Environment Science and Management****Credit and Semester System****2021 admission onwards****Semester I**

Sl. No.	Course Code	Name of the Course	Credits	Credits Required	Total Credits
01	ES M 21 C 01	Ecology and Environment	3	18	24
02	ES M 21 C 02	Environmental Geosciences	3		
03	ES M 21 C 03	Environmental Chemistry	3		
04	ES M 21 C 04	Environmental Pollution and Control	3		
05	ES M 21 C 05	Research Methodology and Statistics	3		
06	ES M 21 C 06	Lab course-I (Environmental Chemistry, Geosciences and Ecology)	3		
07	ES M 21 E 07	Introduction to Disasters and its management	2	6	
08	ES M 21 E 08	Energy Resources	2		
09	ES M 21 E 09	Nature Studies-Field skills and techniques	2		
10	ES M 21 E 10	Introduction to Remote Sensing, GNSSs and GIS	2		

**Semester II**

Sl. No.	Course Code	Name of the Course	Credits	Credits Required	Total Credits
11	ES M 21 C 11	Analytical Techniques and Instrumentation	3	18	24
12	ES M 21 C 12	Environmental Laws, Ethics, Education and Policy	3		
13	ES M 21 C 13	Environmental Economics and Sustainable Development	3		

14	ES M 21 C 14	Environmental Biotechnology and Waste Management	3		
15	ES M 21 C 15	Biodiversity and Conservation Biology	3		
16	ES M 21 C 16	Lab course-II (Environmental Chemistry, Environmental microbiology, Biotechnology, RS & GIS)	3		
17	ES M 21 E 17	Ecotoxicology	2	8/6	
18	ES M 21 E 18	Green Chemistry and Nano Technology	2		
19	ES M 21 E 19	Fundamentals of Management	2		
20	ES M 21 E 20	Environmental Microbiology	2		

### **Semester III**

Sl. No.	Course Code	Name of the Course	Credits	Credits Required	Total Credits
21	ES M 21 C 21	Environmental Management	3	18	24
22	ES M 21 C 22	Environmental Engineering	3		
23	ES M 21 C 23	Environmental Impact Assessment	3		
24	ES M 21 C 24	Resource Management	3		
25	ES M 21 C 25	Lab course III (RS & GIS and Instrumental analysis)	3		
26	ES M 21 C 26	Group Project	3		
27	ES M 21 E 27	Climate Change and Governance	2	2	
28	Open course			4	

### **Semester IV**

Sl. No.	Course Code	Name of the Course	Credits	Credits Required	Total Credits
<b>29</b>	ES M 21 C 28	Project Course	4	4	16
	ES M 21 C 29	Project Work (Report/Thesis)	12	12	

# **SYLLABUS**


## **M.Sc. Environment Science and Management**

**Credit and Semester System**

**2021 admission onwards**

**SEMESTER I**



	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the Course : ES M21 C 01 Ecology and Environment</b>

<b>School Name</b>	School of Environmental Sciences						
<b>Programme</b>	M.Sc. Environment Science and Management						
<b>Course Name</b>	Ecology and Environment						
<b>Type of Course</b>	Core						
<b>Course Code</b>	ES M21 C 01						
<b>Names of Academic Staff &amp; Qualifications</b>	Dr. Syllas V.P., MSc., PhD						
<b>Course summary &amp; Justification</b>							
<b>Semester</b>		<b>1</b>	<b>Credit</b>			<b>3</b>	
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>	
						<b>54</b>	
<b>Pre-requisite</b>	The students have basic understanding and readings on ecology and environmental science						

<b>CO No.</b>	<b><i>At the end of the course, the student will be able to:</i></b>	<b>Taxonomic Level (TL)</b>	<b>PSO No.</b>
<b>1.</b>	Explain the concept of ecology and relevance of environmental science	U	1
<b>2</b>	Able to distinguish the structure, organization and processes in various ecosystems	A	1, 10
<b>3.</b>	Develop a knowledge on the structural and functional aspects of a population as an ecological unit	Ap	1, 2



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**Name of the Course : ES M21 C 01  
Ecology and Environment**

<b>4</b>	Understand and analyse the concept of biological community, changes and interactions within community	U, A	6,9
<b>5</b>	Develop skill on applied aspects of ecology including mathematical or conceptual model of population or community dynamics to analyse the various factors of population growth and regulation.	Cr	7, 8

<b>Unit</b>	<b>Course Description</b>	<b>Hours</b>	<b>CO No.</b>
<b>1.0</b>	<b>Introduction</b>	<b>11</b>	1,2
1.1	Basic concepts of Environment –	2	1
1.2	Multidisciplinary approach	2	1,2
1.3	Basic concepts - Science, Matter and Energy	2	1,
1.4	Evolution of earth, origin of species, diversity and distribution of species	<b>3</b>	1
	Global environmental issues – an introduction	2	1, 2
<b>2.0</b>	<b>Ecology</b>	<b>12</b>	2, 3
2.1	Definition, History of ecology, Subdivisions, Ecology and other subjects.	2	2
	Fundamental ecological variables	2	2, 3
2.2	Ecosystems: Definition, Components, Structure and function and size	3	2
2.3	Classification of ecosystems	3	2
2.4	Comparative Ecosystem Ecology	2	2,3
<b>3.0</b>	<b>Population Ecology</b>	<b>10</b>	3,5
3.1	Definition, Structure and Measures	2	3




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Ecology and Environment**


3.2	Population growth,	2	3
3.3	Regulation strategies of species	2	3
3.4	Survivability Population genetics	2	3
3.5	Human population	2	3,5
<b>4.0</b>	<b>Community Ecology</b>	<b>10</b>	4, 5
4.1	Concepts, Community gradients, Characters of community	2	4
4.2	Ecological Succession and climax Community	3	4
4.3	Organization -interactions between species	3	4
4.4	Stress ecology and adaptation	2	4,5
<b>5.0</b>	<b>Applied Ecology</b>	<b>11</b>	3,4, 5
5.1	Estimating abundance, species diversity measures	2	3
5.2	Diversity indices	2	5
5.3	Mathematical ecology : Eco-informatics	2	5
5.4	Museology	1	5
5.5	Taxonomy and Biosystematics	2	3, 4,
5.6	Biomass productivity and estimation techniques	2	3,4,

Teaching and Learning Approach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning (Video), interactive Instruction:, Active co-operative learning, Seminars, Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative; Field work and field visits
Assessment Types	<ol style="list-style-type: none"> <li>Continuous Internal Assessment (CIA) <ul style="list-style-type: none"> <li>Internal test</li> <li>Assignments based on the theory</li> <li>Seminar Presentation</li> <li>Field visit report</li> </ul> </li> <li>Semester End examination</li> </ol>


 <p>The logo of Mahatma Gandhi University, Kottayam, featuring a circular emblem with a central geometric design and the motto 'विद्या अमृतममृतम्' below it.</p>	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the Course : ES M21 C 01 Ecology and Environment</b>

## References

1. Brewer,R.(1994), The Science of Ecology, Saunders College Publishing, New York.
2. Chapman, J. L. And Reiss, M. J. (1992), Ecology: Principles and Application, Cambridge University Press, Cambridge.
3. Groombridge, B. (ed) 1992. Global Biodiversity: Status of the Earth's Living Resources, Chapman and Hall, London.
4. Hughes, J,D. 2001. An Environmental History of the World. Routledge, London.
5. Michael, P. 1990. Ecological methods for Laboratory and Field Investigations, Tata McGrew Hill Publishing Company Ltd, New Delhi.
6. Odum,E.P.1971.Fundamentals of ecology
7. Sutherland, W. J. 2004. 1997. Ecological Census Techniques - A Handbook. CambridgeUniversityPress.P336.


	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the Course: ES M21 C 02</b> <b>Environmental Geosciences</b>

<b>School Name</b>	School of Environmental Sciences						
<b>Programme</b>	M.Sc. Environment Science and Management						
<b>Course Name</b>	Environmental Geosciences						
<b>Type of Course</b>	Core						
<b>Course Code</b>	ES M21 C 02						
<b>Names of Academic Staff &amp; Qualifications</b>	Dr. Baiju K.R. MSc., PhD						
<b>Course summary &amp; Justification</b>	The course describes the relation between the earth systems and geological agents to the environment. It explains various geological processes involved in the formation of environment and the impacts due the exploration of geological resources.						
<b>Semester</b>		<b>1</b>	<b>Credit</b>			<b>3</b>	
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>	
		<b>40</b>	<b>8</b>		<b>8</b>	<b>54</b>	
<b>Pre-requisite</b>	Basic knowledge about the Earth						

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	<b>Name of the Course: ES M21 C 02</b> <b>Environmental Geosciences</b>

<b>CO No.</b>	<i>At the end of the course, the student will be able to:</i>	<b>Taxonomic Level (TL)</b>	<b>PSO</b>
<b>1.</b>	Explain the basics of Earth systems its processes and landforms	U	1
<b>2</b>	Distinguish various Plate tectonic processes and resultant features	A	1
<b>3.</b>	Identify major minerals, rocks and structures on the Earth	Ap	1
<b>4</b>	Distinguish the major land forms formed by the action of various geological agents	A	1, 4
<b>5</b>	Analyse the interrelationship between various spheres (Atmosphere, Lithosphere and Hydrosphere) of the Earth	E	1
<b>6</b>	Describe the various resources of the earth and its environmental impacts due its exploration	U	2, 3
<b>7</b>	Appraise the different geo-scientific approaches for sustainable environment	E	2

<b>Unit</b>	<b>Course Description</b>	<b>Hours</b>	<b>CO No.</b>
<b>1</b>	<b>The Earth as a System</b>	<b>9</b>	
1.1	Earth in relation to Universe- Origin of the solar system-Geologic Times scale – The Geologic Record – Evolution of life	3	<b>1</b>
1.2	Earth as a System of Interacting Components –Lithosphere, atmosphere, Hydrosphere	2	<b>1, 5</b>
1.3	Plate Tectonics: Interior of the earth- – Types of Plate boundaries-Plate mosaic – Rates of plate motion – Plate reconstruction – Mantle convection. Geological processes related to Plate tectonics-	4	<b>1, 2</b>

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	<b>Name of the Course: ES M21 C 02 Environmental Geosciences</b>

	Seafloor spreading, Mountain building, Earthquakes, Volcanism		
<b>2</b>	<b>Materials of the earth</b>	<b>10</b>	
2.1	Introduction to Rock-forming minerals and their Physical properties	2	<b>3</b>
2.2	Types of Rocks: igneous, metamorphic and sedimentary Major Rock types - Origin and composition– The rock cycle	3	<b>3</b>
2.3	Geological Structures: folds, faults and joints	3	<b>3</b>
2.4	Disintegration of rocks: Weathering: Types of weathering, Formation of Soil, Soil profile.	2	<b>1, 3</b>
<b>3</b>	<b>Introduction to Physical Geology and Geomorphology</b>	<b>10</b>	
3.1	Geological agents and Landforms: Streams- Geological work of streams and land forms; Glaciers- types and land forms, Wind: Geological work of wind and land forms; Oceans: Shoreline process – wave erosion, deposition or accretion; modification of shorelines	7	<b>4</b>
3.2	Geomorphology of India and Kerala: Brief description of different important units	3	<b>4</b>
<b>4</b>	<b>The Hydrosphere</b>	<b>8</b>	
4.1	Hydrological cycle-Aquifers – types and properties, water table and Ground water movement  Ground water recharge-recharge areas-discharge areas	3	<b>1, 5</b>
4.2	Methods of ground water abstraction-undesirable side effects of over exploitation-threats to ground water system-physical destruction of aquifers-ground water depletion-degradation of ground water quality-point source of contamination-diffuse source of contamination- aquifer vulnerability-aquifer over exploitation-	4	<b>5, 6</b>
4.3	Sustainable ground water development and management	1	<b>5, 6, 7</b>




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**Name of the Course: ES M21 C 02  
Environmental Geosciences**

<b>5</b>	<b>The Atmosphere</b>	<b>7</b>	
5.1	Structure and composition of the atmosphere	1	<b>5</b>
5.2	Interaction between lithosphere and atmosphere: Winds, Precipitation etc.  Wind – types and formation,  Precipitation – rainfall, snow fall.	3	<b>5</b>
5.3	Humidity and radiation  Monsoon, El Nino, Droughts, Tropical Cyclones	3	<b>5</b>
<b>6</b>	<b>Geological Resources and the Environment</b>	<b>10</b>	
6.1	Major geological resources- minerals, rocks, coal, oil and natural gas	2	<b>6</b>
6.2	Environmental impacts of rocks/mineral mining and processing, River sand mining and its environmental concern  Rock Quarrying, Clay mining and its impacts	3	<b>6, 7</b>
6.3	Shoreline activities and its environmental impacts	2	<b>1,6,7</b>
6.4	Geological issues in the disposal of domestic waste and industrial waste	3	<b>7</b>




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	<b>Name of the Course: ES M21 C 02 Environmental Geosciences</b>

Teaching and Learning Approach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning (Video), interactive Instruction:, Active co-operative learning, Seminars, Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative; Field work and field visits
Assessment Types	<ol style="list-style-type: none"> <li>1. Continuous Internal Assessment (CIA) <ul style="list-style-type: none"> <li>Internal test</li> <li>Review of Book /Article</li> <li>Seminar Presentation</li> <li>Field visit report</li> </ul> </li> <li>2. Semester End examination</li> </ol>

## References

1. Duff and Holmes 2016 (third edition), Holmes Principles of Physical Geology, Cheltenham, England ; Nelson Thornes
2. Earle, S. (2015). Physical Geology. Victoria, B.C.: BCcampus. Retrieved from <https://opentextbc.ca/geology/> 719 p
3. Fetter CW 1990 Applied Hydrogeology CBS New Delhi 592 p
4. Grotzinger et al 2007 Understanding Earth, WH Freeman New York , 579 p
5. Mukerjee, P.K. 2013 A Textbook of Geology, The World Press Pvt. Ltd, Kolkata, 638p
6. Soman K 2001 Geology of Kerala Geological Society of India Bangalore 430 p.
7. Stewart RH 2007 Introduction to Physical Oceanography 353 p
8. Todd, D K and Mays L W. 2004 Groundwater Hydrogeology, Wiley
9. Tyrrell, GW 1978 The Principles of PETROLOGY, Springer, 368 p DOI <https://doi.org/10.1007/978-94-011-6026-1>

	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the Course : ES M21 C 03</b> <b>Environmental Chemistry</b>

<b>School Name</b>	<b>School of Environmental Sciences</b>						
<b>Programme</b>	<b>M.Sc. Environment Science and Management</b>						
<b>Course Name</b>	<b>Environmental Chemistry</b>						
<b>Type of Course</b>	<b>Core</b>						
<b>Course Code</b>	<b>ES M21 C 03</b>						
<b>Names of Academic Staff &amp; Qualifications</b>	<b>Dr. C.T. Aravindakumar, MSc., PhD</b>						
<b>Course summary &amp; Justification</b>	The course describes the basics of chemistry involved in various environmental processes. It explains the chemical characteristics of environmental matrices such as atmosphere, water and soil. It explains various chemical processes involved in the formation of pollutants in the environment.						
<b>Semester</b>		<b>1</b>	<b>Semester</b>			<b>1</b>	
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>	
						<b>60</b>	
<b>Pre-requisite</b>							

<b>CO No.</b>	<b>At the end of the course, the student will be able to:</b>	<b>Taxonomic Level (TL)</b>	<b>PSO</b>
<b>1.</b>	Describe the basics of environmental chemistry	R	1
<b>2</b>	Demonstrate knowledge of chemical and biochemical principles of fundamental environmental processes in air, water, and soil.	U	1, 3




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**Name of the Course : ES M21 C 03  
Environmental Chemistry**


3.	Describe the chemistry of air, water and soil pollutants	E	3
4.	Apply basic chemical concepts to analyse chemical processes involved in different environmental problems (air, water & soil)	Ap	2
5.	Describe Chemical and physical factors involved in Fate and transport of pollutants	Ap	1, 3
6.	Explain energy crisis and different aspects of sustainability	E	2, 6
7.	Discuss local and global environmental issues	A	2, 4

Unit	Course Description	Hours	CO No.
<b>1</b>	<b>Man and environment</b>		
1.1	Definition. Principles and scope of Environmental Science. Chemistry and the Environment. Man and Environment.	<b>4</b>	<b>1,7</b>
1.2	Water and the hydrosphere, Air and the atmosphere	<b>3</b>	<b>1,2</b>
1.3	Energy and cycles of energy, Chemical fate and transport.	<b>4</b>	<b>1,6</b>
<b>2</b>	<b>Chemistry of the environment - basics</b>		
2.1	Mass and Energy transfer across the various interfaces, material balance.	<b>4</b>	<b>1,2</b>
2.2	First and Second law of thermodynamics. Heat transfer processes, Chemical potential; Chemical equilibria, acid· base reaction.	<b>4</b>	<b>1,2</b>
2.3	Solubility product, solubility of gases in water, the carbonate system.	<b>3</b>	<b>1,2</b>
2.4	Unsaturated and saturated hydrocarbons, radionuclide's	<b>3</b>	<b>1,2</b>
<b>3</b>	<b>Atmospheric chemistry</b>		

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	<b>Name of the Course : ES M21 C 03 Environmental Chemistry</b>

3.1	The atmosphere Composition of Air: Classification of elements, chemical speciation. Particles, ions and radicals in the atmosphere.	4	3
3.2	Chemical and photochemical reactions in the atmosphere, reactions of atmospheric oxygen,	4	3,5
3.3	Chemical processes for formation of inorganic and organic particulate matter. Chemistry of air pollutants, Photochemical smog.	4	3,4,7
3.4	Energy transfer in atmosphere, Global climate and microclimate,	3	5,7
<b>4</b>	<b>Aquatic chemistry</b>		
4.1	Fundamentals of aquatic chemistry, The importance of water, The properties of water, gases in water	4	3,5
4.2	Calcium and other metals in water, Polyphosphates and phosphonates in water	3	3
4.3	Concept of DO, BOD, COD, sedimentation, coagulation, filtration, Redox potential.	4	4
<b>5</b>	<b>Soil Chemistry</b>	3	3
5.1	Nature and decomposition of soil, Inorganic and organic components of soil,	3	3,5
5.2	Acid base and ion exchange reactions in soils, macro and micronutrients in soil, Nitrogen pathways, NPK in soils.	3	3,7


Teaching and Learning Approach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning (Video), interactive Instruction: Active co-operative learning, Seminars, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative.
Assessment Types	1. Continuous Internal Assessment (CIA), Internal test Review of Book /Article Seminar Presentation

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	<b>Name of the Course : ES M21 C 03 Environmental Chemistry</b>

	2. Semester End examination
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### References

1. Manahan Stanley E ., Environmental chemistry, Lewis Publishers London
2. Nyle C Brady, Nature and Properties of Soil, Macmillan
3. M. N. Rao and H V N Rao, Air Pollution, Mc GRAW HILL
4. James Girard, Principles of Environmental Chemistry
5. David T. Allen, Green Engineering: Environmentally Conscious Design of Chemical Processes
6. Phyllis Buell , Chemistry Fundamentals: An Environmental Perspective (2nd Edition)

	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the Course : ES M21 C 04 Environmental Pollution and Control</b>

<b>School Name</b>	<b>School of Environmental Sciences</b>						
<b>Programme</b>	<b>M.Sc. Environment Science and Management</b>						
<b>Course Name</b>	<b>Environmental Pollution and Control</b>						
<b>Type of Course</b>	<b>Core</b>						
<b>Course Code</b>	<b>ES M21 C 04</b>						
<b>Names of Academic Staff &amp; Qualifications</b>	<b>Dr. Mahesh Mohan , MSc., PhD</b>						
<b>Course summary &amp; Justification</b>	The course describes different types of environmental pollution like air, water, soil etc. and types and sources of pollutants including emerging contaminants. The course explains the interaction and movement of pollutants through the environment. It will also describe the control measures for various pollution.						
<b>Semester</b>		<b>1</b>	<b>Semester</b>			<b>1</b>	
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>	
						<b>60</b>	
<b>Pre-requisite</b>							

<b>CO No.</b>	<b>At the end of the course, the student will be able to:</b>	<b>Taxonomic Level (TL)</b>	<b>PSO</b>
<b>1.</b>	Identify and distinguish the sources and types of water, air, and soil pollution.	R	2, 3

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	<b>Name of the Course : ES M21 C 04 Environmental Pollution and Control</b>

<b>2</b>	Articulate knowledge about impact and control measures of water, air, and soil pollution.	U	3
<b>3.</b>	Describe environmental analysis for various water, air and soil quality parameters	E	3, 8
<b>7</b>	Expound the water and waste water treatment	U	5
<b>5</b>	Explain Fate and transport of pollutants and distinguish the regional and global impact of pollution	A	2, 3
<b>6</b>	Describe Radioactive pollution and radioactive waste management methods	U	5
<b>7</b>	Conduct environmental sampling and analysis	Ap	7, 8

Unit	Course Description	Hours	CO No.
<b>1</b>	<b>Air Pollution</b>		
1.1	Air Pollution – Definition and Sources - Natural and anthropogenic; Types of Pollutants- Primary and Secondary. Acid rain, Smog-Photochemical and Classical; Ozone depletion	<b>2</b>	<b>1</b>
1.2	Factors affecting air pollution, Transport and diffusion of pollutants. Gas laws governing the behaviour of pollutants in the atmosphere.	<b>3</b>	<b>5</b>
1.3	Indoor air pollution – Types and sources of pollutants	<b>2</b>	<b>1</b>
1.4	Effects of pollutants on human beings, plants, animals, materials and on climate.  Identification of aeroallergens. Air-borne diseases and allergies.	<b>3</b>	<b>2</b>
1.5	Air pollution control	<b>2</b>	<b>2</b>
1.6	Noise Pollution and control : Characteristics of noise, sources, Effects of noise, Standards, Measurement and control	<b>2</b>	<b>1,2</b>



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**Name of the Course : ES M21 C 04  
Environmental Pollution and Control**

<b>2</b>	<b>Water Pollution</b>		
2.1	Water Pollution - Types -surface and ground water, Surface water pollution-Sources – point and nonpoint, Types of pollutants – chemical, physical and biological	<b>3</b>	<b>1</b>
2.2	Chemical pollutants – inorganic (metals and other elements) and organic (POPs); Nutrients and Eutrophication, Organic matter - sources and degradation. Biological pollutants Microbial pollution	<b>3</b>	<b>1</b>
2.3	Ground water pollution – sources and types of pollutants, Geological and anthropogenic pollutants in ground water – Arsenic, Fluoride, Saline water intrusion etc. Movements of contaminants in ground water,	<b>3</b>	<b>1</b>
2.4	Coastal and Marine pollution-Oil spills, Thermal pollution, Impacts of water pollution	<b>2</b>	<b>1</b>
2.5	Heavy metals and other POPs in aquatic systems - cycling and interactions, Fate and transport of pollutants- factors affecting, Global oceanic transport of pollutants	<b>2</b>	<b>1,5</b>
2.6	Management of point and non-point sources of water pollution, water pollution control, Role of State and Central Pollution Control Boards	<b>2</b>	<b>2, 7</b>
<b>3</b>	<b>Soil Pollution</b>		
3.1	Soil/sediment Pollution – sources and types, soil as a pollutant, Soil quality parameters-Physico-chemical parameters of soil quality, factors affecting pollutants in the sediments – texture, pH, redox potential, organic carbon etc.	<b>3</b>	<b>1</b>
3.2	Sedimentation rate and contamination profile, sediment pollution indices	<b>2</b>	<b>1,5</b>
3.3	Soil Pollution Control. Industrial waste effluents and heavy metals, their interactions with soil components. Soil micro-organisms and their functions, Degradation of different	<b>3</b>	<b>2</b>






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**Name of the Course : ES M21 C 04  
Environmental Pollution and Control**

	insecticides, fungicides and weedicides in soil. Different kinds of, synthetic fertilizers (NP & K) and their interactions with different components of soil.		
<b>4</b>	<b>Environmental Pollution monitoring</b>		
4.1	Monitoring-online and offline, Environmental sampling and analysis – stages (sampling, treatment, detection and interpretation), scope and criteria, Sampling – water, air and soil, equipment for air, water and soil sampling. Analysis – types and methods, Speciation, Certified reference materials,	<b>4</b>	<b>3,7</b>
4.2	Water quality parameters-physical, chemical and biological, analysis, Water quality standards, Tracers – dyes and isotopes in pollution monitoring	<b>4</b>	<b>3,7</b>
4.3	Ambient Air quality Monitoring, Air quality Standards-ambient and emission, Air Sampling equipment. Methods of monitoring and control of air pollution SO <sub>2</sub> , NO, CO, CO <sub>2</sub> , Ozone, SPM-PM <sub>2.5</sub> & PM 10. Air quality index. Noise measurement	<b>3</b>	<b>3,7</b>
4.4	Soil/sediment sampling and monitoring. Soil quality standards. Methods for assessing pollutant contamination profile in the sediments – chronology and pollutant detection	<b>2</b>	<b>3,7</b>
<b>5</b>	<b>Radioactive Pollution</b>		
5.1	Radioactivity in the environment, Radioactive Pollution: Radionuclides- sources, types of radiation, Radioactive fallout,	<b>2</b>	<b>1, 6</b>
5.2	Ecological risks from radiation, effects on humans, exposure standards.	<b>2</b>	<b>1,6</b>
5.3	Control measures: radioactive waste treatment.	<b>2</b>	<b>2,6</b>
<b>6</b>	<b>Emerging contaminants</b>		
6.1	Emerging contaminants – definition, types and sources Sources and health impacts of PPCPs, POPS, PCCDS, PFAs,	<b>2</b>	<b>1,2</b>


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	<b>Name of the Course : ES M21 C 04 Environmental Pollution and Control</b>

	Dioxins, PCBs etc.		
6.2	Plastics pollution in the freshwater and marine ecosystems Natural disasters and Pollution –	<b>2</b>	<b>1,2</b>

Teaching and Learning Approach	
Assessment Types	1. Continuous Internal Assessment (CIA) Internal test Review of Book /Article Seminar Presentation Field visit report 2. Semester End examination

## References

1. Baxter, M. (2013). Social and Ethical Aspects of Radiation Risk Management, Vol.19, Editors: Deborah Oughton Sven Hansson. Elsevier (Pub.). Series: Radioactivity in the Environment.
2. Brady, N.C. (1996). The Nature and Properties of Soil, 10<sup>th</sup> Ed., Prentice Hall of India Pvt. Ltd.
3. Cherimisinoff, N.P. (2001). Biotechnology for Waste and wastewater treatment, Prentice Hall of India Pvt. Ltd.
4. Helmut Meuser (2010). Contaminated Urban Soils, Springer.
5. Luyben, W. L. Process Modeling Simulation and Controls for Chemical Engineers, Mc. Graw Hill Book Co.
6. Mahajan, S.P. (1998). Pollution control in process industries, Tata McGraw Hill, New Delhi.
7. Masters, G.M. (1998). Introduction to Environmental Engineering and Science 3rd ed. Prentice Hall of India Pvt. Ltd.
8. Metcalf and Eddy (2003). Wastewater engineering: Treatment, Disposal, Reuse, 4<sup>th</sup> edition. Tata McGraw Hill, New Delhi.

	<b>MAHATMA GANDHI UNIVERSITY</b>
<b>Name of the Course : ES M21 C 04 Environmental Pollution and Control</b>	

9. Miller R.W. and Donalvee, R.L. (1997). Soils in Our Environment, 7<sup>th</sup> Ed, Prentice Hall of India Pvt. Ltd.
10. Nathanson, J.A. (2003). Basic Environmental Technology, 4<sup>th</sup> Ed., Prentice Hall of India Pvt. Ltd.
11. Parsons, S.A. and Jefferson, B. (2006). Introduction to potable water treatment processes, Blackwell Publishing.
12. Poonia and Sharma (2018)., Environmental Engineering, Khanna Books, ISBN: 9789386173577, 9386173573.
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14. Sharma, B.K. (2001). Water Pollution. Goel Pub. House. Meerut.
- Wadhwa, Y. (2009). Air Pollution: Causes and Control. Cyber Tech Publications, New Delhi

***Suggested readings***

15. [http://echo2.epfl.ch/VICAIRE/mod\\_2/chapt\\_9/main.htm](http://echo2.epfl.ch/VICAIRE/mod_2/chapt_9/main.htm)
16. <http://www.bis.org.in/>
17. <http://www.science.uwaterloo.ca/~cchieh/cact/applychem/watertreatment.html>
18. <http://www.sciencedirect.com/science/journal/02697491?sdc=1>
19. <http://www.water-pollution.org.uk/types.html>
20. [https://en.wikipedia.org/wiki/Water\\_pollution](https://en.wikipedia.org/wiki/Water_pollution)
21. <https://link.springer.com/journal/11270>
22. <https://www.journals.elsevier.com/atmospheric-pollution-research/>
23. <https://www.journals.elsevier.com/environmental-pollution/>
24. [https://www.sciencedaily.com/terms/water\\_pollution.htm](https://www.sciencedaily.com/terms/water_pollution.htm)



**MAHATMA GANDHI UNIVERSITY**

**Name of the course : ES M21 C 05  
Research Methodology and Statistics**

<b>School Name</b>	<b>School of Environmental Sciences</b>					
<b>Programme</b>	<b>M.Sc. Environment Science &amp; Management M.Sc. Environment Science &amp; Disaster Management</b>					
<b>Course Name</b>	<b>Research Methodology and Statistics</b>					
<b>Type of Course</b>	<b>Elective</b>					
<b>Course Code</b>	<b>ES M21 C 05</b>					
<b>Names of Academic Staff &amp; Qualifications</b>	<b>P. Padma, M.A., M.Phil., M.Ed.,</b>					
<b>Course summary &amp; Justification</b>	The course deals with the general research methodology and statistical practices for environmental sciences and disaster management.					
<b>Semester</b>		<b>1</b>	<b>Credit</b>			<b>3</b>
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>
						<b>54</b>
<b>Pre-requisite</b>	Basic research aptitude and knowledge in statistics					

<b>CO No.</b>	<b>At the end of the course, the student will be able to:</b>	<b>Taxonomic Level (TL)</b>	<b>PSO</b>
<b>1.</b>	Describe the various research methods and statistical technique for doing research	U	7,8
<b>2</b>	Infer the literature; data analysis and result presentation procedures.	U	7
<b>3.</b>	Develop testing hypothesis for research	A	7
<b>4</b>	Appraise various statistical technique for doing research	E	8
<b>5</b>	Interpret and explain research articles in their academic discipline.	U	7,8
<b>6</b>	Apply statistical soft wares for data analysis	A	8



**MAHATMA GANDHI UNIVERSITY**

**Name of the course : ES M21 C 05  
Research Methodology and Statistics**

<b>Unit</b>	<b>Course Description</b>	<b>Hours</b>	<b>CO No.</b>
<b>1</b>	<b>I. RESEARCH METHODOLOGY</b>	<b>26</b>	
1.1	<b>Meaning-</b> Objectives- motivation- Significances of research, Types of research, Research methods and methodology, Research and Scientific Method, Criteria of Good research, Problems of researcher	4	1,2
1.2	<b>Selection of the problem:</b> Criteria for selection of problem and evaluating problems, Statement of problem formulation and definition.	2	4,5
1.3	<b>Research design:</b> Meaning, need for research design, Features and important concepts relating to research design, Different research design, Basic principles of experimental design.	3	1,2
1.4	<b>Survey of literature:</b> Different methods of surveying literature, different sources of information, internet, search engines, web sites, recording surveying information.	2	2
1.5	<b>Hypothesis:</b> Nature, types and sources of hypothesis, characteristics of a good hypothesis.	2	3
1.6	<b>Sampling:</b> Unit of sampling, population: techniques, characteristics of good samples, different types of sample, sampling errors and ways to reduce them.	3	1,2,5
1.7	<b>Collection and analysis and interpretation of data:</b> Procedure of data collection, scoring of data, tabulation, editing and analysis and interpretation of data.	3	4,6
1.8	<b>Research Report:</b> Composition, pagination, Title pages, Systems of indicating references, Bibliography, Appendices.	3	4,5,6
1.9	<b>Mini project</b> for data analysis	4	5,6
	<b>II. Statistics</b>	<b>20</b>	
<b>2</b>	<b>Fundamental Statistics</b>		
2.1	<b>Introduction</b> – Importance and limitation.	1	1
2.2	<b>Classification and Tabulation</b> of data	1	1,2



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**Name of the course : ES M21 C 05  
Research Methodology and Statistics**

2.3	<b>Graphical Representation</b>	2	1,2
2.4	<b>Measures of Central Tendencies</b> – Mean, Median and Mode	2	3,4
2.5	<b>Measures of Dispersion</b> - Range, Standard Deviation and Co-efficient of Variation	2	3,4
2.6	<b>Moments, Skewness and Kurtosis</b>	2	3,4
2.7	<b>Correlation and Regression</b> – Scatter diagrams – Karl Pearson’s Coefficient of correlation – Rank correlation – Linear and Curvilinear regressions.	3	4,5
2.8	<b>Probability</b> – Frequency approach- Addition and multiplication theorems- Binomial, Poisson and Normal Distribution- Probit analysis (Graphic Method only)	3	4
2.9	<b>Testing of Hypothesis:</b> Null and Alternative Hypothesis – Two types of error – Level of significance Test based on t, Z, F, Chi –square and Analysis of Variance – one-way, two-way, three-way analysis.	4	4,5,6
<b>3</b>	<b>Application of Computer in Statistics</b>	<b>8</b>	5,6
3.1	Data analysis using packages - MS excel	8	

Teaching and Learning Approach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning (Video), interactive Instruction: Active co-operative learning, Seminars, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative.
Assessment Types	<ol style="list-style-type: none"> <li>Continuous Internal Assessment (CIA) <ul style="list-style-type: none"> <li>Internal test</li> <li>Assignment</li> <li>Seminar Presentation</li> <li>Mini project for data analysis</li> </ul> </li> <li>Semester End examination</li> </ol>




**MAHATMA GANDHI UNIVERSITY**

**Name of the course : ES M21 C 05  
Research Methodology and Statistics**


## References

1. Ahuja Ram, Research Methods, Rawath Jaipur.
2. Babbie Earl, Research methods in sociology, Cengage Learning Australia.
3. Denscombe Martyn, The good research guide: for small scale social research projects, Viva Books New Delhi.
4. Devendra Thakur, Research methodology in social science, Deep & Deep Publications New Delhi
5. Gurumani N, Research methodology for Biological Sciences, MJP Publishers Chennai
6. Holmes Debbie Moody Peter Dine Diana, Research methods for the biosciences, Oxford New york.
7. Kothari C R, Research methodology: methods and techniques, Wiswa Prakashan New Delhi.
8. Mohankumar P S , Handbook on research methodology, Right Publishers Kudanechoor
9. Narwal S S Dahiya S S Singh J P, Research methods in Plant science, Allelopathy Vol 1, Soil analysis, Scientific Publishers Jodhpur.
10. Prabhakar V K, Research methodology and system analysis, Anmol New Delhi
11. Santosh Gupta, Research methodology and statistical techniques, Deep & Deep Publications New Delhi
12. Barnett Vic, Environmental statistics, methods and applications. JhonWiley & Sons New York.
13. Gupta S P, Statistical methods, Sultan Chandh New Delhi
14. Kozak Antal Kozak Robert A Staudhammer Christina L Watts Susan B, Introductory Probability and Statistics, applications for forestry and the natural sciences, Cab International Wallingford.
15. Levin Richard I Rubin David S, Statistics for Management, Edition 7, P H I New Delhi
16. Miller Jane, Statistics for advanced level, Ed.2, University Press Cambridge.

	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the Course: ES M21 C 06</b> <b>Lab course-I</b>


<b>School Name</b>	<b>School of Environmental Sciences</b>						
<b>Programme</b>	<b>M.Sc. Environment Science and Management</b>						
<b>Course Name</b>	<b>Lab course-I (Environmental Chemistry, Geosciences and Ecology)</b>						
<b>Type of Course</b>	<b>Core</b>						
<b>Course Code</b>	<b>ES M21 C 06</b>						
<b>Names of Academic Staff &amp; Qualifications</b>	<b>Dr. Mahesh Mohan, Dr. Syllas VP., Dr. Baiju KR</b>						
<b>Course summary &amp; Justification</b>	The course will enable students to understand various physico-chemical parameters determining water, air and soil quality and to carry out environmental sampling and analysis. It will also enable students to identify rock and minerals and carry out geological field work. The students will understand biodiversity and can carry out biodiversity assessment.						
<b>Semester</b>		<b>1</b>	<b>Semester</b>			<b>1</b>	
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>	
						<b>60</b>	
<b>Pre-requisite</b>	Theoretical knowledge in basics of environmental sciences						



	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the Course: ES M21 C 06</b> <b>Lab course-I</b>

CO No.	<i>At the end of the course, the student will be able to:</i>	Taxonomic Level (TL)	PSO
1.	Understand the basic principles of the analysis of water, air, soil quality parameters	U	1, 2, 3, 4, 6
2	Carry out analysis of physico-chemical parameters of air, water and soil	U	1, 2, 6
3.	Conduct noise pollution measurement	Ap	1, 3
4	Carry out ecological assessment	Ap	1, 3, 5
5	Identify various rocks and minerals	Ap	1, 3
6	Draw rose diagrams for various geological analysis	A	6, 8
7	Conduct geological field survey	Ap	6, 8

Unit	Course Description	Hours	CO No.
<b>1</b>	<b>Environmental Chemistry</b>	<b>13</b>	<b>1, 2, 3</b>
1.1	Volumetric Analysis: Basic Principles	4	1, 2, 3
1.2	Acidimetry and Alkalimetry—Estimation of hydrochloric acid, sodium carbonate, oxalic acid	3	1, 2, 3
1.3	Permanganometry- Mohr's salt, potassium permanganate	4	1, 2, 3
1.4	Gravimetric analysis	2	1, 2, 3
<b>2</b>	<b>Water and Noise quality</b>	<b>12</b>	<b>1, 2, 3</b>
2.1	Colour, turbidity, conductivity, TDS, TSS, TS, pH, acidity, alkalinity, chloride, salinity, hardness, DO, BOD	10	1, 2, 3


	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the Course: ES M21 C 06 Lab course-I</b>

2.2	Noise analysis	2	3
<b>3</b>	<b>Ecology</b>	<b>14</b>	<b>4</b>
3.1	Biodiversity assessment : Quadrata method	6	4
3.2	Plankton analysis	4	4
3.3	Zooplankton analysis	4	4
<b>4</b>	<b>Environmental Geosciences</b>	<b>21</b>	<b>5, 6, 7</b>
4.1	Identification of rocks and minerals	6	5
	Soil analysis- Physical (Texture, Bulk density, moisture content) and chemical parameters (pH, OC/OM, EC)	8	5, 6
4.2	Rose diagrams- Wind rose	4	6
4.3	Measuring strike and dip of rock formations. Basic map reading.	3	6, 7

Teaching and Learning Approach	Laboratory practical's
Assessment Types	1. Continuous Internal Assessment (CIA) Internal test Review of Book /Article Seminar Presentation Field visit report 2. Semester End examination

## References

1. APHA (1995).Standard methods for the examination of water and wastewater. 19<sup>th</sup> edition American Public Health Association, Washington, DC
2. Abbasi S A, Water quality sampling and analysis, Discovery Publishing New Delhi

 <p>The logo of Mahatma Gandhi University, Kottayam, featuring a circular emblem with a central geometric design and the motto 'विद्यया अमृतमपश्य' (Vidya Amritam Apashya) written below it.</p>	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the Course: ES M21 C 06</b> <b>Lab course-I</b>

3. Christian Gary D, Analytical Chemistry, JhonWiley& Sons New York.
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5. Maiti, S.K. (2003) Handbook of methods in environmental studies, Vol. 2: Air, noise, soil, overburden, solid waste and ecology. ABD Publishers, Jaipur.
6. Marc Pansu, Jacques Gautheyrou, Hand book of soil analysis- Mineralogical, organic and inorganic methods, Springer, New York
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10. NEERI, Air quality monitoring, A course manual (Photostat), NEERI Nagpur.



**MAHATMA GANDHI UNIVERSITY**

**Name of the course: ES M21 E 07  
Introduction to Disasters and its Management**

<b>School Name</b>	<b>School of Environmental Sciences</b>					
<b>Programme</b>	<b>M.Sc. Environment Science and Management</b>					
<b>Course Name</b>	<b>Introduction to Disasters and its management</b>					
<b>Type of Course</b>	<b>Elective</b>					
<b>Course Code</b>	<b>ES M21 E 07</b>					
<b>Names of Academic Staff &amp; Qualifications</b>	<b>Dr. Baiju K.R. MSc., PhD</b>					
<b>Course summary &amp; Justification</b>	The course deals with the major natural and anthropogenic disasters its environmental constraints. The course also elaborates on the basic disaster management strategies employed worldwide.					
<b>Semester</b>		<b>1</b>	<b>Credit</b>			<b>2</b>
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>
						<b>36</b>
<b>Pre-requisite</b>						

<b>CO No.</b>	<i>At the end of the course, the student will be able to:</i>	<b>Taxonomic Level (TL)</b>	<b>PSO</b>
<b>1.</b>	Explain the relation between Earth's processes and disasters	U	1, 2



**MAHATMA GANDHI UNIVERSITY**

**Name of the course: ES M21 E 07  
Introduction to Disasters and its Management**

<b>2</b>	Distinguish various types and causative factors of disasters	An	1, 2
<b>3.</b>	Illustrate the key concepts of disaster management	U	2
<b>4</b>	Analyse the International disaster management system	An	6
<b>5</b>	Assess the disaster management strategies in India	E	9, 10

<b>Unit</b>	<b>Course Description</b>	<b>Hours</b>	<b>CO No.</b>
<b>1.</b>	<b>Environment and Disasters</b>	<b>7</b>	<b>1, 2</b>
1.1	Science and Facts of Natural Hazards. Earth's processes as disasters: Internal and external	3	1
1.2	Characteristics. Causal factors and characteristics of disasters.	2	2
1.3	Climate change and Disasters	2	2
<b>2</b>	<b>Types and Classification of Disasters</b>	<b>8</b>	<b>1,2</b>
2.1	Natural Disasters: Meteorological disasters, Geological disasters, Biological disasters	4	1,2
2.1	Anthropogenic Disasters: Chemical, Industrial and Nuclear related Disasters, Accident related Disasters	4	1,2
<b>3.</b>	<b>Disaster Management Concepts</b>	<b>6</b>	<b>3</b>
3.1	Introduction to key concepts, terminologies and their complexities (Hazard, vulnerability, Exposure, Risk, Crisis, emergencies, Vulnerability, Disasters, Resilience)	3	3



**MAHATMA GANDHI UNIVERSITY**

**Name of the course: ES M21 E 07  
Introduction to Disasters and its Management**

3.2	Disaster management Spectrum and its components Scope of DM and Disaster Management Cycle	3	3
<b>4</b>	<b>International Disaster management System</b>	<b>7</b>	<b>3,4</b>
4.1	Organizations, bodies and Finance. International Strategies and functions. Role of United Nations in Disaster management.	3	4
4.2	International Disaster management support system. Unified response strategy.	2	3,4
4.3	Mapping Disasters using global datasets. National and international information networks and inventories	2	3,4
<b>5</b>	<b>Disaster Management in Indian Context</b>	<b>8</b>	<b>3, 5</b>
5.1	Major Disasters in India. National Vulnerability profile	2	3
5.2	National Disaster management Hierarchy and Institutionalisation	2	5
5.3	National Disaster Decision support system. Technological applications. Role of research organisations.	2	3, 5
5.4	Challenges of disasters in India	2	5



**MAHATMA GANDHI UNIVERSITY**

**Name of the course: ES M21 E 07  
Introduction to Disasters and its Management**

Teaching and Learning Approach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning (Video), interactive Instruction:, Active co-operative learning, Seminars, Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative; Field work and field visits
Assessment Types	1. Continuous Internal Assessment (CIA) Internal test Review of Book /Article Seminar Presentation Field visit report 2. Semester End examination

## References

1. Coppola D. P., 2007. Introduction to International Disaster Management. Elsevier Butterworth-Heinemann
2. Peduzzi P., Dao H., and Herold C., 2005. Mapping Disastrous Natural Hazards Using Global Datasets Natural Hazards Volume 35, Number 2, 265-289,
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5. Kapur A., Neeti, Meena, Deepthima, Roshani and Debanjali, Disasters in India Studies of Grim Reality. Rawat Publications, New Delhi



**MAHATMA GANDHI UNIVERSITY**

**Name of the Course: ES M21 E 08  
Energy Resources**

<b>School Name</b>	<b>School of Environmental Sciences</b>					
<b>Programme</b>	<b>M.Sc. Environment Science and Management</b>					
<b>Course Name</b>	<b>Energy Resources</b>					
<b>Type of Course</b>	<b>Elective</b>					
<b>Course Code</b>	<b>ES M21 E 08</b>					
<b>Names of Academic Staff &amp; Qualifications</b>	<b>Dr. E.V.Ramasamy, M.Tech., Ph.D</b>					
<b>Course summary &amp; Justification</b>						
<b>Semester</b>		<b>1</b>	<b>Credit</b>			<b>2</b>
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>
						<b>36</b>
<b>Pre-requisite</b>						

<b>CO No.</b>	<b>At the end of the course, the student will be able to:</b>	<b>Taxonomic Level (TL)</b>	<b>PSO</b>
<b>1.</b>	Describe the basics of energy, their units; understand different forms of Energy and their transfer ; Gains an idea of Global Energy Status	U, R	1, 4, 6
<b>2</b>	Understand and classify sources of Energy based on renewability; To understand the functioning of a Nuclear Power plant and Evaluate the sustainability of Nuclear Energy; To assess the Environmental Impacts of Energy resources.	U,A,E	4, 6





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**Name of the Course: ES M21 E 08  
Energy Resources**

<b>3.</b>	Classify different kinds of renewable Energy sources; To assess the Environmental Impacts	U,E	1, 2
<b>4</b>	Understand different energy resources available in India; to assess their potential at present and in future	U,A,E,R	1, 2
<b>5</b>	To assess the environmental pollution and other issues associated with energy generation and consumption. Identify suitable techniques to solve environmental issues.	U,A,Ap.	1, 3, 4
<b>6</b>	Explain the importance of Energy Auditing and list different categories of Energy Auditing .Plan to conduct a suitable energy audit for different kinds of energy users.	U, R,C	7, 8

<b>Unit</b>	<b>Course Description</b>	<b>Hours</b>	<b>CO No.</b>
<b>1</b>	<b>Fundamentals of Energy System</b>	<b>7</b>	
1.1	Fundamentals of energy, work, power and units Energy transformations – laws of thermodynamics	3	<b>1</b>
1.2	Flow of energy and cycle of matter in the human ecosystem: Energy for household, industrial and agricultural uses.	2	<b>1,2</b>
1.3	History and geography of energy development and energy related pollution; Concepts of Conventional, Non-conventional, Renewable, Non-renewable and Alternate energy resources	2	<b>2,3</b>
<b>2</b>	<b>Non-Renewable Energy Resources</b>	<b>16</b>	
2.1	Fossil fuels: Coal, Pete, Oil, Oil shale, Tar sands, Natural gas	8	<b>1,3</b>
2.2	Non-fossil fuels: Nuclear power; Ecological and social impacts (Advantages and Disadvantages) of major thermal and nuclear power plants	6	<b>2,3</b>



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**Name of the Course: ES M21 E 08  
Energy Resources**

2.3	Management of energy projects and its environmental impacts Environmental impacts of non-renewable energy resources	2	<b>2,3</b>
<b>3</b>	<b>Renewable Energy Resources</b>	<b>16</b>	
3.1	Solar Energy: Technique for harvesting solar energy, direct utilization of solar energy by thermal conversion thermo-mechanical conversion, Helio-electric conversion, Photo-voltaic conversion, indirect utilization through water power- Ocean Thermal Energy Conversion (OTEC), Solar ponds	6	<b>2,3</b>
3.2	Wind resources: Mapping of wind resources area, wind power stations, wind turbines – types, efficiency: Betz limit Geothermal sources, Tidal energy and Ocean waves- Possibilities and limitations	6	<b>2,3</b>
3.3	Biomass based energy- Biogas systems, petro-plants, dendrothermal energy Environmental impacts of renewable resources	4	<b>2,3</b>
<b>4</b>	<b>Energy Resources Indian Status</b>	<b>6</b>	
4.1	Fuel wood resources in India Fossil fuel- coal, oil natural gas – National status	2	<b>3,4</b>
4.2	Hydropower in the country Nuclear power in India	2	<b>4</b>
4.3	Renewable energy resources in India: Thermal energy, solar energy, wind energy, biomass based energy and other renewable energy sources (tidal, ocean waves and geothermal)	2	<b>4</b>
<b>5</b>	<b>Energy Related Environmental Issues</b>	<b>2</b>	
5.1	Environmental pollution associated with energy generation and	2	<b>4, 5</b>



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**Name of the Course: ES M21 E 08  
Energy Resources**

	consumption process Energy pricing techniques for controlling environmental problems (air pollution)		
<b>6</b>	<b>Energy Audit</b>	<b>3</b>	
6.1	Types of audits- walk through energy audit, intermediate energy audit, and comprehensive energy audit Recommended practices	2	<b>5</b>
6.2	Performing the energy audit- details- computer simulation, developing the report	1	<b>5</b>

Teaching and Learning Approach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning (Video), interactive Instruction: Active co-operative learning, Seminars, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative.
Assessment Types	<ol style="list-style-type: none"> <li>1. Continuous Internal Assessment (CIA) <ul style="list-style-type: none"> <li>• Assignments</li> <li>• Seminar Presentation on selected topics</li> <li>• Quiz</li> <li>• Class tests</li> </ul> </li> <li>2. Semester End examination</li> </ol>

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**Name of the Course: ES M21 E 08  
Energy Resources**

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**MAHATMA GANDHI UNIVERSITY**

**Name of the Course: ES M21 E 08  
Energy Resources**

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**MAHATMA GANDHI UNIVERSITY**

**Name of the course: ES M21 E 09  
Nature Studies – Field skills and Techniques**

<b>School Name</b>	<b>School of Environmental Sciences</b>						
<b>Programme</b>	<b>M.Sc. Environment Science and Management</b>						
<b>Course Name</b>	<b>Nature Studies-Field skills and techniques</b>						
<b>Type of Course</b>	<b>Elective</b>						
<b>Course Code</b>	<b>ES M21 E 09</b>						
<b>Names of Academic Staff &amp; Qualifications</b>	<b>Dr. Mahesh Mohan, Dr. Syllas VP., Dr. Baiju KR</b>						
<b>Course summary &amp; Justification</b>	The course will enable students to understand the sampling protocols of water, air and soil/sediment quality. It will also enable students to identify rock and minerals and carry out geological field work. The students will be able to conduct quadrat study.						
<b>Semester</b>		<b>1</b>	<b>Semester</b>			<b>1</b>	
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>	
						<b>36</b>	
<b>Pre-requisite</b>							



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**Name of the course: ES M21 E 09  
Nature Studies – Field skills and Techniques**

<b>CO No.</b>	<b><i>At the end of the course, the student will be able to:</i></b>	<b>Taxonomic Level (TL)</b>	<b>PSO</b>
<b>1.</b>	Understand the basics of sampling of water and sediment, soil and air	U	1
<b>2</b>	Conduct the sampling of air, water and soil	Ap	3, 5
<b>3.</b>	Conduct the sampling aquatic organisms	Ap	3, 5
<b>4</b>	Carry out biodiversity assessment	Ap	3
<b>5</b>	Conduct quadrat study	Ap	3
<b>6</b>	Identify various rocks and minerals	U	1
<b>7</b>	Conduct geological field survey	Ap	1

<b>Unit</b>	<b>Course Description</b>	<b>Hours</b>	<b>CO No.</b>
<b>1</b>	<b>Water quality Monitoring</b>	<b>12</b>	<b>1, 2, 3</b>
1.1	Water sampling	4	1,2
1.2	Sediment sampling	2	1, 2
1.3	Sampling of planktons and benthos	4	1, 3
1.4	Sampling of other aquatic organisms	2	1, 3
<b>2</b>	<b>Soil &amp; Air quality monitoring</b>	<b>6</b>	<b>1, 2</b>
2.1	Soil sampling	2	1, 2
2.2	Air sampling – particulate and gaseous sampling	2	1, 2
2.3	Collection of weather data	2	1, 2



**MAHATMA GANDHI UNIVERSITY**

**Name of the course: ES M21 E 09  
Nature Studies – Field skills and Techniques**

<b>3</b>	<b>Ecology</b>	<b>9</b>	<b>4, 5</b>
3.1	Biodiversity assessment : Quadrature method	3	4, 5
3.2	Plotting large quadrates in Forests	2	5
3.3	Wild life Census	2	4
3.4	Collection of samples for plant taxonomy	2	4
<b>4</b>	<b>Environmental Geosciences</b>	<b>9</b>	<b>6, 7</b>
4.1	Identification of rocks and minerals in the field	3	6, 7
4.2	Measuring strike and dip of rock formations.	3	7
4.3	Data collection for Rose diagram (rocks)	2	7
4.4	Basic map reading.	1	7

Teaching and Learning Approach	Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative; Field work and field visits
Assessment Types	<ol style="list-style-type: none"> <li>1. Continuous Internal Assessment (CIA) <ul style="list-style-type: none"> <li>Internal test</li> <li>Review of Book /Article</li> <li>Seminar Presentation</li> <li>Field visit report</li> </ul> </li> <li>2. Semester End examination</li> </ol>

**References**

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**MAHATMA GANDHI UNIVERSITY**

**Name of the course: ES M21 E 09  
Nature Studies – Field skills and Techniques**

3. Conklin Alfred R. Introduction to Soil chemistry, analysis and Instrumentation, John Wiley & Sons New York
4. Mamata Tomar, Quality Assessment of Water and Waste Water, Lewis Publishers London
5. Marc Pansu, Jacques Gautheyrou, Hand book of soil analysis- Mineralogical, organic and inorganic methods, Springer, New York
6. Maria Csuros and CsabaCsuros, Environmental Sampling and Analysis for Metals, Lewis Publishers
7. Miroslav Radojevic and Vladimir N Bashkin, Practical Environmental Analysis, RSC Publishing
8. NEERI , Air quality monitoring, A course manual (Photostat), NEERI Nagpur



**MAHATMA GANDHI UNIVERSITY**

**Name of the course: ES M21 E 10  
Introduction to Remote Sensing, GNSSs and GIS**

<b>School Name</b>	<b>School of Environmental Sciences</b>					
<b>Programme</b>	<b>M.Sc. Environment Science and Management</b>					
<b>Course Name</b>	<b>Introduction to Remote Sensing, GNSSs and GIS</b>					
<b>Type of Course</b>	<b>Core</b>					
<b>Course Code</b>	<b>ES M21 E 10</b>					
<b>Names of Academic Staff &amp; Qualifications</b>	<b>Dr. Abin Varghese. MSc., M. Phil., Ph. D</b>					
<b>Course summary &amp; Justification</b>	Teaching of critical spatial thinking in higher education empowers graduates to effectively engage with spatial data. Geoinformatics has wide application across many science disciplines; we evaluate how this contributes to critical spatial thinking. The discipline of GIS covers the whole process of spatial decision-making in environment as well as disaster management. We outline how some existing GIS principles could be improved to focus on the development of critical spatial thinking skills, competences and abilities that are valuable to graduates.					
<b>Semester</b>	<b>1</b>	<b>Credit</b>			<b>3</b>	
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>
		<b>40</b>	<b>14</b>	<b>0</b>	<b>0</b>	<b>54</b>
<b>Pre-requisite</b>						



**MAHATMA GANDHI UNIVERSITY**

**Name of the course: ES M21 E 10  
Introduction to Remote Sensing, GNSSs and GIS**

<b>CO No.</b>	<b><i>At the end of the course, the student will be able to:</i></b>	<b>Taxonomic Level (TL)</b>	<b>PSO</b>
1.	Demonstrate the basics of mapping concepts and Geodesy	U	1
2	Understand the various data formats and data types in GIS	U	6
3.	Understand the significance of various satellite based remote sensing products	U	6
4	Apply the spatial and non- spatial data using various methods	Ap	7,8
5	Appraise the importance of spatial planning in environment management	E	6,7,8
6	Design methods to solve the environmental issues based on various spatial data products	C	1, 2, 6, 7. 8
7	Outline and Evaluate the role of navigational satellite systems in geoinformatics	U, E	7, 8

<b>Unit</b>	<b>Course Description</b>	<b>Hours</b>	<b>CO No.</b>
<b>1</b>	<b>Geodetical aspects, mapping concepts and surveying</b>	<b>10</b>	<b>1</b>
1.1	Earth System – Geodesy: Datum/Spheroids and coordinate systems, map projection - different projections and their characteristics	4	1
1.2	Features on the earth's surface: their basic properties – discrete vs continuous and geometries of representation	2	1
1.3	Cartography: Maps – their characteristics and elements, types - Basic surveying principles and techniques: EDMs and GNSSs; GNSSs – segments, various constellations, errors, differential correction and precise positioning. Map reading and interpretation  Global, national and state mapping agencies and their	4	1



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**Name of the course: ES M21 E 10  
Introduction to Remote Sensing, GNSSs and GIS**

	authorized reference maps – general & thematic		
<b>2</b>	<b>Remote sensing: Introduction</b>	<b>10</b>	<b>3</b>
2.1	Remote sensing system – components and principles – platforms, sensors, medium, target, interactions and their characteristics including various resolutions, concept of DN value, radiance, reflectance, emission	3	<b>3</b>
2.2	Electromagnetic spectrum - energy interaction with atmosphere and earth surface, atmospheric windows, spectral properties of various objects on the earth's surface and the concept of spectral signature, active and passive remote sensing.	4	<b>3</b>
2.3	Space borne earth observation: various orbits and their characteristics, operations, image acquisition and various data products  Indian remote sensing programme& Other satellites and sensors like Landsat, SPOT, etc.	3	<b>3</b>
<b>3</b>	<b>Digital Image Processing</b>	<b>10</b>	<b>3, 5, 6</b>
3.1	Various image formats, loading and visualization – panchromatic and multispectral colour visualization – TCC and FCCs.	3	<b>3,5</b>
3.2	Image restoration – geometric, radiometric – atmospheric errors and their correction  Image enhancements – single band, multiband operations – layer stacking, rationing and various indices, PCT, TCT, resolution merging/image fusion	4	<b>3,6</b>
3.3	Image interpretation – visual and digital; visual interpretation elements and key  Digital image classification – unsupervised and supervised; accuracy assessment	3	<b>3,6</b>



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**Name of the course: ES M21 E 10  
Introduction to Remote Sensing, GNSSs and GIS**

<b>4</b>	<b>Geographical Information System (GIS): Basics</b>	<b>10</b>	<b>2, 4</b>
4.1	Concepts, components and organisation of GIS  Representing & modelling spatial features and processes - vector and raster structures, relationship between features – topology; raster data compressions and storage formats	4	2
4.2	Non-spatial/attribute Database Management Systems (DBMS), significance of DBMS, principles, data types, models – RDBMS, data storage, query and retrieval	3	2
4.3	Basic GIS functions: data inputting methods & various data sources, data management, data manipulation and geographic analysis and output presentation.	3	2,4
<b>5</b>	<b>Global Navigational Satellite Systems: Basics</b>	<b>6</b>	<b>4, 5, 7</b>
5.1	Basic concepts of Global Navigational Satellite Systems (GNSSs): History and timeline, overview. Components of GNSSs (Space Segment, Control Segment, User Segment), GPS working principle, -	3	5, 7
5.2	GPS (Global positioning System), - GLONASS, Galileo ,BeiDou, NavIC, GPS signals (L1 and L2 Frequencies)/ Course-Acquisition (C/A) code Precision (P) code,	3	4, 7
<b>6</b>	<b>Geographic analysis and modelling</b>	<b>8</b>	<b>2, 3, 5, 6</b>
6.1	Exploration, query, vector spatial analysis & geo processing – extraction, proximity, overlay  Network analysis – route, trace, closest facility, allocation	3	2,5,6
6.2	Raster based spatial modeling and analysis – density, distance, map algebra – arithmetic & weighted overlay: multi-criteria decision making	3	3,5,6
6.3	Surface modeling and analysis: DEM creation – input sources, interpolation; slope, aspect, volume, profile, hill shade, view	2	3,5,6



**MAHATMA GANDHI UNIVERSITY**

**Name of the course: ES M21 E 10  
Introduction to Remote Sensing, GNSSs and GIS**

	shed, visibility, contouring		
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Teaching and Learning Approach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning (Video), interactive Instruction:, Active co-operative learning, Seminars, Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative; Field work and field visits
Assessment Types	<ol style="list-style-type: none"> <li>Continuous Internal Assessment (CIA) <ul style="list-style-type: none"> <li>Internal test</li> <li>Review of Book /Article</li> <li>Seminar Presentation</li> <li>Field visit report</li> </ul> </li> <li>Semester End examination</li> </ol>

**References**

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**MAHATMA GANDHI UNIVERSITY**

**Name of the course: ES M21 E 10  
Introduction to Remote Sensing, GNSSs and GIS**

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**MAHATMA GANDHI UNIVERSITY**

**Name of the course: ES M21 E 10  
Introduction to Remote Sensing, GNSSs and GIS**

25. Zeleny M. 1982. Multiple Criteria Decision Making, Mc-Graw Hill.



**SEMESTER II**



MAHATMA GANDHI UNIVERSITY

Name of the Course : ES M21 C 11  
Analytical Techniques and Instrumentation

School Name	School of Environmental Sciences					
Programme	M.Sc. Environment Science and Management					
Course Name	Analytical Techniques and Instrumentation					
Type of Course	Core					
Course Code	ES M21 C11					
Names of Academic Staff & Qualifications	Dr. C.T. Aravindakumar					
Course summary & Justification	The course will discuss on various classical and modern analytical techniques. After the program, the students will able to do the gravimetric, volumetric, and instrumental method of analysis.					
Semester		2	Semester			2
Total Student Learning Time (SLT)	Learning approach	Lecture	Tutorial	Practical	Others	Total hrs
						60
Pre-requisite						

CO No.	At the end of the course, the student will be able to:	Taxonomic Level (TL)	PSO
1.	Explain the analytical errors and describe clean analysis	R	3
2	Explain gravimetric, volumetric, spectroscopic and chromatographic analysis	R,U	3
3.	Do gravimetric, volumetric, spectroscopic and	Ap	3



MAHATMA GANDHI UNIVERSITY

Name of the Course : ES M21 C 11  
Analytical Techniques and Instrumentation

	chromatographic analysis		
7	Explain the applications of gravimetric and volumetric methods	U	3, 5
5	Describe the applications of spectroscopic methods	U	3, 5
6	Explain radiation detectors	R	3
7	Describe the applications of chromatographic methods	U	3, 4, 5

Unit	Course Description	Hours	CO No.
<b>1</b>	<b>Introduction</b>		
1.1	Significant figures, Accuracy and precision	2	1
1.2	Types of errors- random and systematic errors, Standard deviation	3	1
<b>2</b>	<b>Gravimetric methods</b>		
2.1	Mechanism of formation of precipitates, Characteristics of ideal precipitate, Methods to improve filterability and minimizing adsorbed impurities	3	2,3
2.2	Precipitation from homogeneous solutions, Organic and inorganic precipitating agents,	3	2,3
2.3	Application of gravimetric methods	3	7
<b>3</b>	<b>Volumetric methods</b>		
3.1	Molarity, Normality, Standard solutions, End point	3	2,3
3.2	Acid-base titrations – titration curves, theory of indicators	2	2,3,7
3.3	Complexometric titrations-EDTA titrations-applications	3	2,3,7
3.4	Iodometry, Iodimetry, Colorimetric titrations	3	2,3,7
<b>4</b>	<b>Spectrochemical methods</b>		




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Name of the Course : ES M21 C 11  
Analytical Techniques and Instrumentation

4.1	Electromagnetic spectrum, Interaction of light with matter/molecule	3	2
4.2	Fundamentals of molecular spectroscopy	3	2
4.3	Wavelength selectors: Filters and Monochromators, Radiation detectors and Transducers	2	2
4.4	Mass spectrometry	3	2,3,5
4.5	Atomic Absorption spectroscopy (AAS), Inductively coupled plasma mass spectrometry (ICP-MS) -principle and applications	4	2,3,5
4.6	Microwave, IR, Electronic, Raman, NMR and ESR spectroscopy-principle	3	2,3,5
4.7	SEM,TEM- instrumentation and applications	2	2,3,5
<b>5</b>	<b>Radiation detectors</b>		
5.1	Dosimetry, Geiger Muller Counter, Scintillation Counter	4	6
5.2	Electrochemical Methods: pH meter- Glass and reference electrodes, Conductivity met	4	6
<b>6</b>	<b>Chromatographic Techniques and environmental applications</b>		
6.1	Paper Chromatography, Thin Layer Chromatography, Column Chromatography, Ion Chromatography	2	2,3,7
6.2	Gas Chromatography(GC), GC-MS	2	2,3,7
6.3	Liquid Chromatography, High Performance Liquid Chromatography (HPLC), LC-MS, LC-MS/MS	3	2,3,7

Teaching and Learning Approach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning (Video), interactive Instruction: Active co-operative learning, Seminars, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative.
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 MAHATMA GANDHI UNIVERSITY KOTTAYAM विद्या अमृतमयम्	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the Course : ES M21 C 11 Analytical Techniques and Instrumentation</b>

<b>Assessment Types</b>	3. Continuous Internal Assessment (CIA) 3. Internal test 4. Review of Book /Article 5. Seminar Presentation 6. Field visit report 4. Semester End examination
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### References

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**MAHATMA GANDHI UNIVERSITY**

**Name of the Course : ES M21 C 12  
Environmental Laws, Ethics, Education and Policy**

<b>School Name</b>	School of Environmental Sciences						
<b>Programme</b>	<b>M.Sc. Environment Science and Management</b>						
<b>Course Name</b>	<b>Environmental Laws, Ethics, Education and Policy</b>						
<b>Type of Course</b>	<b>Core</b>						
<b>Course Code</b>	ES M21 C12						
<b>Names of Academic Staff &amp; Qualifications</b>	<b>Adv. Somanathan, Dr. Mahesh Mohan , MSc., PhD;</b>						
<b>Course summary &amp; Justification</b>	The course deals with the history of environmental laws and their evolution to modern environmental laws. The course discusses various international treaties and conventions conducted for environmental protection. It also describes various policies and laws in India for the protection of the environment. The course explains the principles of international laws. Environmental education, its history and present status in India are also described in this course.						
<b>Semester</b>		<b>2</b>	<b>Semester</b>			<b>2</b>	
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>
							<b>60</b>
<b>Pre-requisite</b>							

<b>CO No.</b>	<b><i>At the end of the course, the student will be able to:</i></b>	<b>Taxonomic Level (TL)</b>	<b>PSO</b>
<b>1</b>	Describe the history of environmental law	R	1,4
<b>2</b>	Articulate the environmental laws and policies in Kerala and India	U	1,2
<b>3</b>	Describe principles of international laws	R	1,9



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Environmental Laws, Ethics, Education and Policy**

<b>4</b>	Expound the forest laws in India	U	1,9,10
<b>5</b>	Describe environmental education	U	9,10
<b>6</b>	Evaluate the development activities based on environmental laws	Ap	2,9
<b>7</b>	Do environmental awareness	Ap	9,10

<b>Unit</b>	<b>Course Description</b>	<b>Hours</b>	<b>CO No.</b>
<b>1</b>	<b>Introduction</b>		
1.1	History of Environmental Regulations	<b>2</b>	<b>1</b>
1.2	Emerging of NGOs like WWF	<b>3</b>	<b>1</b>
1.3	United Nations Conference on Human Environment (Stockholm Conference – 1972),	<b>2</b>	<b>1</b>
1.4	Environmental treaties before 1990	<b>1</b>	<b>1</b>
1.5	International literature and report on human environment – The limits to growth, Our common future,	<b>3</b>	<b>1</b>
1.5	General principles and concepts of international Environmental law: Precautionary principle; Polluter pays principle; Sustainable development; Public trust doctrine. Overview of legislations and basic concepts	<b>2</b>	<b>3</b>
<b>2</b>	<b>Environmental Policy in India</b>		
2.1	Environmental Legislation Protection Laws in India – Ancient and Pre- Independence.	<b>3</b>	<b>2</b>
2.2	Environmental Legislation in Post – Independence Period	<b>3</b>	<b>2</b>
2.3	Constitutional and Legislative Provisions in India. <ul style="list-style-type: none"> <li>• Fundamental principle; 42<sup>nd</sup> Amendment Act; Direct Principles</li> <li>• Fundamental Rights,</li> </ul>	<b>3</b>	<b>2</b>




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Environmental Laws, Ethics, Education and Policy**

	<ul style="list-style-type: none"> <li>Environmental Legislations (General)</li> </ul>		
	Environmental Protection Act of 1986		
2.4	Judicial Remedies and Procedures. <ul style="list-style-type: none"> <li>Tort Law, Public Nuisance , Public Interest Litigation, Freedom of information</li> </ul>	2	2
<b>3</b>	<b>Laws Relating to control of Pollution and Environment in India</b>		
3.1	Water Act and Related Acts, Rules and Regulations	3	2
3.2	Air Act – Related Acts, Rules and Regulations	2	2
3.3	Noise and Land Pollution Rules and Regulations	3	2
3.4	Rules and Notification made under Environmental (Protect) Act 1986 – Rules of Hazardous Microorganisms. Bio–medical waste, Recycled Plastics, Ozone Depleting Substances, Solid Waste Management, etc.	4	2
3.6	Environmental Laws and regulations in Kerala - Mining law, laws related to wetlands and other ecosystems	3	2
3.7	Case studies – Bhopal gas tragedy	1	2
<b>4</b>	<b>Forest and Wild Life Protection Act and Rules.</b>		
4.1	Forest policies and Legislation in Pre – independence Period.	2	2,4
4.2	Wildlife and Biodiversity: IFA, 1927; WLPA, 1972; FCA, 1980; Biological Diversity Act, 2002; Forest Rights Act, 2006.	3	2,4
4.3	Strategies for conservation–Project Tiger, Elephant, Rhino etc.	2	2,4,6
<b>5</b>	<b>International Organisation, Conservations and Protocols</b>		
4.1	United Nations, GEMS, UNEP, GEF, WCN etc.	3	3,7
4.2	Conventions after 1990: Rio, Rio+10, Rio+20, Kyoto protocol etc.	4	3,6,7



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<b>6</b>	<b>Information, Education and Communication</b>		
5.1	Environmental education/awareness, lifestyle changes and consumerism. Values and ethics	<b>1</b>	<b>5,7</b>
5.2	Environmental education in India, Information Networks – ENVIS Centers – INFOTERA etc.	<b>2</b>	<b>5,7</b>
5.3	Role of NGO's in the Implementation of Environmental Policies.	<b>2</b>	<b>5,7</b>
5.4	Communication and Management.	<b>1</b>	<b>5,7</b>

Teaching and Learning Approach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning (Video), interactive Instruction: Active co-operative learning, Seminars, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative.
Assessment Types	1. Continuous Internal Assessment (CIA) Internal test Review of Book /Article Seminar Presentation Field visit report 2. Semester End examination

## References


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2. Santhakumar, S., (2001), Environmental Law, Surya Publication, Chennai
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**Name of the Course : ES M21 C 12  
Environmental Laws, Ethics, Education and Policy**

7. Simon Bill and Stuart Bill (1995) Environmental Law, Blackstone Press Ltd, London.
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	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the Course : ES M21 C 13</b> <b>Environmental Economics and Sustainable Development</b>

<b>School Name</b>	School of Environmental Sciences						
<b>Programme</b>	<b>M.Sc. Environment Science and Management</b>						
<b>Course Name</b>	<b>Environmental Economics and Sustainable Development</b>						
<b>Type of Course</b>	<b>Core</b>						
<b>Course Code</b>	ES M21 C 13						
<b>Names of Academic Staff &amp; Qualifications</b>	<b>P. Padma., M.A., M.Phil., M.Ed.,</b>						
<b>Course summary &amp; Justification</b>							
<b>Semester</b>		<b>2</b>	<b>Credit</b>			<b>3</b>	
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>	
						<b>60</b>	
<b>Pre-requisite</b>							

<b>CO No.</b>	<b><i>At the end of the course, the student will be able to:</i></b>	<b>Taxonomic Level (TL)</b>	<b>PSO</b>
<b>1.</b>	Explain the basics of concepts and theories of environmental economics and sustainable development	U	1, 2
<b>2</b>	Distinguish various problems which threatens sustainability	A	2, 4
<b>3.</b>	Identify methods, tools, and techniques for sustainability	R	6
<b>4</b>	To build at the individual level, qualitative and quantitative skills/capabilities for bringing essential environmental considerations into economic planning, policies and	Ap	7

	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the Course : ES M21 C 13</b> <b>Environmental Economics and Sustainable Development</b>

	developmental projects,		
<b>5</b>	Describe the environmental problems and its impacts	E	1, 7
<b>6</b>	To synthesize the new field of environment and economics in an holistic approach towards solution of environmental problems	C	7, 8


<b>Unit</b>	<b>Course Description</b>	<b>Hours</b>	<b>CO No.</b>
<b>1</b>	<b>Integrating Environment and Economics</b>	<b>4</b>	
1.1	History: The evolution of economic and environmental thinking. Elementary economic principles applied in environmental economics - theory of consumption, production, prices, market (equilibrium and failure) Market, policy, and environmental degradation	3	<b>1,2,3</b>
1.2	Economy, Environment – Interface: Material Balance Principle Energy.	1	<b>1,4,5</b>
<b>2</b>	<b>Fundamental concepts and theories in Environmental Economics</b>	<b>11</b>	
2.1	Environmental economics – meaning, scope and limitations	1	<b>1,3</b>
2.2	Basic Theory of Environmental Economics.	2	<b>1,3,4</b>
2.3	Environmental quality as a public good and its efficient level	2	<b>1,3,4</b>
2.4	Economic efficiency, Property Rights, Market failure and externalities - taxes, permits externalities as public goods, internalizing externalities, Coase’s Theorem and its Critique	2	<b>1,3</b>
2.5	Cost- Benefit Analysis (CBA) and its Applications	2	<b>1,3,4,5,6</b>
2.6	Welfare economics: Welfare aspects of Environmental Economics - Principle of maximum social welfare - Pareto Criterion	2	<b>1,3,5</b>
<b>3</b>	<b>Environmental and Natural Resources (energy and water)</b>	<b>21</b>	



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**Name of the Course : ES M21 C 13  
Environmental Economics and Sustainable Development**

	<b>Accounting</b>		
3.1	Population and environment.	1	<b>1,4,5</b>
3.2	Global Issues – Climate Change , Resource Depletion, Waste management etc.,	5	<b>1,4,5</b>
3.3	Natural Resources Management: Brown, Green and Blue Economies	4	<b>1,4,5,6</b>
3.4	Carbon trading, Emissions trading and Clean Development Mechanisms	4	<b>1,4,5,6</b>
3.5	Circular Economy : A futuristic approach	4	<b>1,4,5</b>
3.6	Environmental Policies -	3	<b>1,2,3,4</b>
<b>4</b>	<b>Sustainability and Sustainable Development</b>	<b>10</b>	
4.1	From problems to crises- Depletion of resources and environmental degradation	1	<b>1,2</b>
4.2	Sustainable Development: Strategies and Policies.	2	<b>1,2,3</b>
4.3	Sustainable human development index, Sustainability pillars	2	<b>1,3</b>
4.4	Gandhian model of sustainable development	1	<b>3,4,5</b>
4.5	Sustainable development goals and achievements.	4	<b>3,4,5</b>
<b>5</b>	<b>Sustainable Consumption</b>	<b>7</b>	
5.1	Definition, importance, relevance for developing countries - Difference between Sustainable Consumption from Sustainable Development and Sustainable Production - key issues -UN Guidelines Sustainable Consumption	3	<b>1,2,3</b>
5.2	Sustainable production and Sustainable consumption	1	<b>1,3</b>
5.3	Sustainable consumption Tools	2	<b>1,2,3</b>
5.4	Sustainable living and values	1	<b>3,4,5</b>

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	<b>Name of the Course : ES M21 C 13</b> <b>Environmental Economics and Sustainable Development</b>

<b>6</b>	<b>Education for Environment and Sustainable Development</b>	<b>7</b>	
6.1	Environmental education	1	<b>1,4,5</b>
6.2	Education for Sustainable Development	1	<b>1,4,5</b>
6.3	Education for sustainable consumption	1	<b>1,4,5</b>
6.4	Eco – School	1	<b>1,4,5,6</b>
6.5	Mini project on resource consumption and conservation	3	<b>4,5,6</b>

Teaching and Learning Approach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning (Video), interactive Instruction: Active co-operative learning, Seminars, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative.
Assessment Types	1. Continuous Internal Assessment (CIA) Internal test Group Presentations Seminar Presentation 2. Semester End examination

## References


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**Name of the Course : ES M21 C 13  
Environmental Economics and Sustainable Development**

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21. Van den Bergh, Jereon C.J.M., (1996). Ecological economics and sustainable development: theory, methods and applications, Edward Elgar, 1996.

	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of course : ES M21 C14</b> <b>Environmental Biotechnology and Waste Management</b>

<b>School Name</b>	School of Environmental Sciences						
<b>Programme</b>	<b>M.Sc. Environment Science and Management</b> <b>M.Sc Environment Science and Disaster Management</b>						
<b>Course Name</b>	Environmental Biotechnology and Waste Management						
<b>Type of Course</b>	<b>Core</b>						
<b>Course Code</b>	ES M21 C 14						
<b>Names of Academic Staff &amp; Qualifications</b>	<b>Dr. E.V. Ramasamy , M.Tech., Ph.D</b>						
<b>Course summary &amp; Justification</b>	<p><b>Course Summary:</b> Application of Biotechnological methods in controlling air, water and soil pollution. Understanding the blend of Ecology and Engineering in wastewater remediation and solid waste management. New concept of Ecological Sanitation (ECOSAN) is introduced in this course.</p> <p><b>Justification :</b> A thorough understanding of waste management (Both Solid and Liquid) with biological methods and information gain on emerging knowledge domains like : Zero waste concept including Design for Environment – Industrial Ecology (IE), Life Cycle Assessment (LCA), Extended Producer Responsibility , Servicing, Ecological sanitation based closing the loop concept (circular economy).</p>						
<b>Semester</b>		<b>2</b>	<b>Credit</b>			<b>3</b>	
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>	
						<b>54</b>	
<b>Pre-requisite</b>							





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**Name of course : ES M21 C14  
Environmental Biotechnology and Waste Management**

<b>CO No.</b>	<b><i>At the end of the course, the student will be able to:</i></b>	<b>Taxonomic Level (TL)</b>	<b>PSO</b>
<b>1.</b>	Describe the basics of molecular biology and environmental biotechnology and its relevance	U, R	1,
<b>2</b>	Understand the techniques involving Biotechnology applicable to combat air, soil and water pollution. To assess the efficiency of different wastewater treatment techniques.	U,A,E	1, 2
<b>3.</b>	Classify different kinds of biotechnological applications in Agriculture like organic fertilisers and biopesticides. Understand the concept Ecological Engineering – a blend of Ecology and Engineering to control water pollution. To apply the appropriate bioplastics producing technique to overcome the plastics menace	U,A	1, 2
<b>4</b>	Understand different solid waste management steps; to assess their potential at present and in future. To describe the need of zero waste concept	U,A,E,R	5, 6
<b>5</b>	Explain the importance of Ecological Sanitation – a new emerging concept of circular economy in sanitation sector.	U, R,C	3, 5


<b>Unit</b>	<b>Course Description</b>	<b>Hours</b>	<b>CO No.</b>
<b>1</b>	<b>Cell Technology and Biotechnology</b>	<b>4</b>	
1.1	Cell: Structure and function – Prokaryotes and Eukaryotes. Nucleic Acids, Central dogma - Protein synthesis, rDNA technology. Fermentation Technology.	2	<b>1</b>
1.2	Plant tissue culture techniques	1	<b>1</b>
1.3	Environmental Biotechnology: an overview.	1	<b>1,2</b>
<b>2</b>	<b>Biotechnological Methods in Pollution Control</b>	<b>16</b>	



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Environmental Biotechnology and Waste Management**

2.1	Air pollution control: Bio-desulphurisation of coal, Green belts.	6	1,2
2.2	Water pollution control: Aerobic and Anaerobic wastewater treatment Systems.	6	2,3
2.3	Bioremediation : Soil / land contaminated with oil spills, PCBs, PAHs; Bioremediation technology; Phytoremediation	2	1,2,3
2.4	Biosensors : Concept and principle ,Biosensors for environmental monitoring	2	1,2
<b>3</b>	<b>Emerging Trends in Environmental Biotechnology</b>	<b>10</b>	
3.1	Agrobiotechnology : Plant genetic engineering – role of rDNA technique; transgenic plants - GM crops, Biopesticides and Biofertilizers	6	2,3
3.2	Ecological Engineering: Constructed / Artificial wetlands, Nutrient Film Technique (NFT).	2	2,3
3.3	Biodegradable plastics – PHBs and PHAs	2	2,3
<b>4</b>	<b>Solid Waste Management</b>	<b>16</b>	
4.1	Municipal Solid Waste : Types, sources , properties and impacts	1	3,4
4.2	Techniques for treatment / processing: Concept of three ‘R’s, Thermal processes – incineration, Pyrolysis, RDF. Biological processes – Anaerobic digestion, Composting and vermicomposting.	8	4
4.3	Disposal techniques: Landfills – design, operation and management.	4	4
4.4	Hazardous waste management.	2	3,4
4.5	Concept of Zero waste	1	1,4


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	<b>Name of course : ES M21 C14</b> <b>Environmental Biotechnology and Waste Management</b>

<b>5</b>	<b>Ecological Sanitation</b>	<b>8</b>	
5.1	Conventional sanitation : a linear flow system – its limitations	1	<b>4, 5</b>
5.2	Eco San –Circular flow and closing the loop : concept, goals and advantages	2	5
5.3	Eco San for human night soil management: Dry Toilets, Composting Toilets UDDT, UDFT.	2	<b>5</b>
5.4	Grey water management	2	<b>3,5</b>
5.5	Eco San - Human Health and Food Security	1	<b>5</b>


Teaching and Learning Approach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning (Video), interactive Instruction: Active co-operative learning, Seminars, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative.
Assessment Types	1. Continuous Internal Assessment (CIA) <ul style="list-style-type: none"> <li>• Assignments</li> <li>• Seminar Presentation on selected topics</li> <li>• Quiz</li> <li>• Class tests</li> </ul> 2. Semester End examination

### References


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<b>Name of course : ES M21 C14</b> <b>Environmental Biotechnology and Waste Management</b>	


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 <p>MAHATMA GANDHI UNIVERSITY KOTTAYAM</p> <p>विद्यया अमृतमपश्यत</p>	<p><b>MAHATMA GANDHI UNIVERSITY</b></p>
<p><b>Name of course : ES M21 C14</b> <b>Environmental Biotechnology and Waste Management</b></p>	

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	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of course : ES M21 C15</b> <b>Biodiversity and Conservation Biology</b>

<b>School Name</b>	<b>School of Environmental Sciences</b>					
<b>Programme</b>	<b>M.Sc. Environment Science and Management</b> <b>M.Sc Environment Science and Disaster Management</b>					
<b>Course Name</b>	<b>Biodiversity and Conservation Biology</b>					
<b>Type of Course</b>	Core					
<b>Course Code</b>	ES M21 C15					
<b>Names of Academic Staff &amp; Qualifications</b>	<b>Dr. Sylas V.P. Ph.D</b>					
<b>Course Summary &amp; Justification</b>	This course allows the students to learn the fundamentals of biodiversity and conservation biology. In environmental Science, biodiversity conservation is an important topic due to extinction and loss of biodiversity due to human activities. Since the subject includes the conservation biology, students will get some basic knowledge for the measures to protect the biodiversity.					
<b>Semester</b>	2		<b>Credit</b>		3	
<b>Total Student Learning Time (SLT)</b>	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Case based learning	32	2	-	6	40
<b>Pre-requisite</b>	As per the requirement of the course					
<i>Others- Case studies , Library, field work, seminar and assignment preparations, test, research article/ case reports discussion etc.</i>						

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<b>CO No.</b>	<b><i>At the end of the course, the student will be able to:</i></b>	<b>Taxonomic Level (TL)</b>	<b>PSO</b>
1	Understand the basic concepts of Biodiversity and conservation biology	A	1, 2, 6
2	Study the distribution, significance and threats of biodiversity	U, An	2,4,6, 10
3	Understand and evaluate the various initiatives for biodiversity conservation	U, E	4,6,9,10
4	Understand and explain the concept of human ecology and natural history.	U, An	1,6, 10
5	Understand and analyse the legal and policy aspects of conservation science	U, An	1,6,9, 10

<b>Unit</b>	<b>Course Description</b>	<b>Hours</b>	<b>CO No.</b>
<b>1</b>	<b>Biodiversity - An introduction</b>	<b>5</b>	<b>1, 2</b>
1.1	The evolution of biodiversity.	1	1
1.2	Theories and Concepts of Biodiversity	1	1, 2
1.3	Origin of species/speciation.	1	1
1.4	The distribution of biodiversity in macro scale	1	1
1.5	Species interactions and biodiversity	1	1
<b>2</b>	<b>Biodiversity</b>	<b>9</b>	<b>1, 2, 3</b>
2.1	Levels of Biodiversity	1	1, 2
2.2	Genetic diversity, species diversity, Eco-system diversity, alpha, beta, gamma	2	1,2
2.3	Global and Regional biodiversity	2	1, 2
2.4	Threats to Biological Diversity – Habitat Degradation, Fragmentation, Global Climate Change, over extraction, over abundance, alien and invasive species, diseases, pollution	3	2
2.5	Endangered and Threatened species, IUCN, Red Data Book	1	2, 3
<b>3</b>	<b>Biodiversity Conservation in Practice</b>	<b>6</b>	<b>1, 2, 3, 4, 5</b>
3.1	Global Conservation initiatives – Biodiversity hot spots,	2	1, 2, 5

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	Conservation in South and Southeast Asia,		
3.2	National Conservation Action Plan	1	2, 5
3.3	Landscape-level Conservation	1	2, 3, 4
3.4	Conservation Strategies	1	2, 3
3.5	In situ and ex situ conservation	1	2, 3
<b>4</b>	<b>Introduction to Conservation Biology</b>	<b>7</b>	<b>1, 2, 3, 4, 5</b>
4.1	History, Concepts and Background	1	1, 4
4.2	Biogeography of India	1	1, 2, 4
4.3	Western Ghats	2	1, 2, 3, 4, 5
4.4	Wild life biology	2	3, 5
4.5	Restoration biology	1	2, 3, 4, 5
<b>5</b>	<b>Natural History</b>	<b>6</b>	<b>1, 2, 3, 4, 5</b>
5.1	Natural History in India	1	1, 4
5.2	Animal Behavior	1	1, 4
5.3	General Entomology, Ornithology, Mammalogy, Ichthyology, Herpetology	2	1, 2, 3
5.4	Basic understanding of common flora in Southern Western Ghats	2	4, 5
<b>6</b>	<b>Human Ecology</b>	<b>4</b>	<b>2, 4, 5</b>
6.1	Environmental History and Conservation Movements	1	4
6.2	People and Nature: Ecosystem services	1	2, 4
6.3	Indigenous communities and Ethnobiology	1	2, 4, 5
6.4	Human-wildlife Conflict	1	2, 4, 5
<b>7</b>	<b>Conservation – Legal and policy framework</b>	<b>3</b>	<b>2, 4, 5</b>
7.1	International treaties - Convention on Biological diversity, CITES, TRAFFIC	1	2, 5
7.2	Legal aspects of conservation in India.	1	5
7.3	Biopiracy – causes and effects	1	2, 4, 5




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	<b>Name of course : ES M21 C15</b> <b>Biodiversity and Conservation Biology</b>

<b>Teaching and Learning Approach</b>	<b>Classroom Procedure (Mode of transaction)</b> Authentic learning, case-based learning, collaborative learning, seminar, group activities.
<b>Assessment Types</b>	<b>Mode of Assessment</b> 1. Continuous Internal Assessment (CIA) 2. Seminar Presentation – 3. Assignments A. Semester End examination

### References

1. Sutherland, W. J. 2004. The Conservation Handbook, Research, Management and Policy, Blackwell Science Ltd. P278.
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3. Michael E. Soule and Bruce Wilcox, 1980. Conservation Biology: An Evolutionary-Ecological Perspective.
4. Lewis, M. 2003. Inventing Global Ecology: Tracking the biodiversity ideal in India, Orient Longman. P369.
5. Martin, G.J. 1995. Ethnobotany - A methods manual. Chapman & Hall. Madras.
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7. Ahmadullah, M and Nayar, M. P. 1987. Endemic plants of the Indian Region. Vol. I Botanical Survey of India.
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	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the course : ES M21 C16 Lab Course II</b>

<b>School Name</b>	School of Environmental Sciences						
<b>Programme</b>	<b>M.Sc. Environment Science and Management</b>						
<b>Course Name</b>	<b>Lab Course II</b> (Environmental Chemistry, Microbiology, Biotechnology, RS & GIS)						
<b>Type of Course</b>	<b>Core</b>						
<b>Course Code</b>	ES M21 C16						
<b>Names of Academic Staff &amp; Qualifications</b>	<b>Dr. Mahesh Mohan; Dr. Syllas V.P.; Dr. E.V. Ramasamy; Dr. Harsha H.T., Dr. Abin Varghese</b>						
<b>Course summary &amp; Justification</b>	The course will enable students to understand various physico-chemical parameters determining water, air and soil quality and to carry out environmental sampling and analysis. It will also enable students to identify microbial pollution of water and soil environment. The students will be able to identify and isolate microbes from the environment. The students will also get acquainted with the RS & GIS technique and become able to do map preparation and other applications of GIS.						
<b>Semester</b>		<b>2</b>	<b>Semester</b>			<b>2</b>	
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>	
						<b>60</b>	
<b>Pre-requisite</b>							



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Lab Course II**

<b>CO No.</b>	<b><i>At the end of the course, the student will be able to:</i></b>	<b>Taxonomic Level (TL)</b>	<b>PSO</b>
<b>1</b>	Understand the basic principles of the analysis of water, air, soil quality parameters	R	3
<b>2</b>	Assess physico-chemical parameters of air, water and soil	Ap	3,5,8
<b>3</b>	Do air pollution Monitoring	Ap	3,8
<b>4</b>	Assess microbial pollution	Ap	3
<b>5</b>	Identify and isolate various microbes from the environment	Ap	3,6
<b>6</b>	Create map using GIS platform and assess remote sensing data	U, Ap, An, E, C	3,6,8
<b>7</b>	Do environmental pollution monitoring	Ap	3,4,6,8


<b>Unit</b>	<b>Course Description</b>	<b>Hours</b>	<b>CO No.</b>
<b>1</b>	<b>Water quality</b>		
1.1	Analysis of COD, Sulphate, Sulphide, Potassium, Iron	<b>4</b>	<b>1,2,7</b>
1.2	Nutrient analysis (Nitrite, Nitrate, TN, Phosphate)	<b>4</b>	<b>1,2,7</b>
1.3	Total and dissolved metals in water	<b>2</b>	<b>1,2,7</b>
<b>2</b>	<b>Environmental microbiology</b>		
2.1	Preparation and characterization of bacteriological media – use of autoclave and hot air oven for sterilisation	<b>2</b>	<b>4,7</b>
2.2	Isolation and enumeration of microorganisms in environmental samples (soil and water)	<b>1</b>	<b>4,5,7</b>




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Lab Course II**

2.3	Pure culture techniques – quadrant streaking, continuous streaking methods	1	4,5,7
2.4	Use of compound microscope	1	4,7
2.5	Staining techniques – Simple stain, Gram stain Endospore staining	1	4,7
2.6	Detection of bacterial motility – hanging drop method, use of semi solid agar	1	4,7
2.7	Basic biochemical test for characterization of bacteria – Oxidase test and catalase test and oxidation/ fermentation (O/F) test	1	4,7
2.8	Membrane filter technique to detect faecal coliforms in water and Escherichia coli  Indole, Methyl Red (MR), Voges-Proskauer and Citrate (IMViC) tests for the 85characterization of E. coli	2	4,7
<b>3</b>	<b>Soil/sediment quality</b>		
3.1	Available Nitrogen, Total Nitrogen, Available Phosphorous, Available potassium	4	1,3,7
3.2	Trace metals	2	1,3,7
<b>4</b>	<b>Air quality</b>		
4.1	Ambient Gaseous pollutant analysis – SO <sub>x</sub> , NO <sub>x</sub> , CO,	4	1,2,3,7
4.2	Ambient particulate monitoring – SPM, RPM	3	1,2,3,7
4.3	Online monitoring of ambient air quality	1	1,2,3,7
<b>5</b>	<b>RS and GIS</b>		
5.1	Understanding base map (Toposheet, Geology map, cadastral map etc.)	2	6

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	Understanding various Software's in GIS (ArcGIS, QGIS),	<b>1</b>	<b>6</b>
5.2	Geo referencing base map	<b>2</b>	<b>6</b>
5.3	Creation of Spatial and Non spatial data(Geo database, Shape files, Attribute data)	<b>4</b>	<b>6</b>
5.4	Creating and editing of Point, Line and Polygon	<b>2</b>	<b>6</b>
5.5	Vector data analysis (Explore, Report generations, Geometry calculations, SQL (Arithmetic and Boolean Operators), Overlay analysis (Clip, Erase, Split, Union, Identity, Intersect)	<b>2</b>	<b>6</b>
5.6	Remote Sensing Open data web portals (Earth Explorer, Bhuvan etc.) Understanding various Satellite Missions and Sensors Learn how to download data	<b>4</b>	<b>6,7</b>
5.7	Creation of Triangular Irregular Network (TIN)	<b>3</b>	<b>6</b>
5.8	Adding various bands of data to Image Processing Software, Understanding various resolution data, Dn values of Pixels	<b>3</b>	<b>6,7</b>
5.9	Layer Stacking	<b>2</b>	<b>6</b>
5.10	Preparation of Various Color Composites (True Color Composite, False Color Composite)	<b>1</b>	<b>6</b>

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	<b>Name of the course : ES M21 C16 Lab Course II</b>


Teaching and Learning Approach	Laboratory Practicals
Assessment Types	1. Continuous Internal Assessment (CIA) Internal test Review of Book /Article Seminar Presentation Field visit report 2. Semester End examination

## References

1. Abbasi S A, Water quality sampling and analysis, Discovery Publishing New Delhi
2. Aileen R. B., A. Jon, K., Muekrcke, P.C. and Juliana O. M. 2016. Map Use: Reading, Analysis, Interpretation, eighth editions
3. APHA (1995). Standard methods for the examination of water and wastewater. 19<sup>th</sup> edition American Public Health Association, Washington, DC
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9. Maiti, S.K. (2003) Handbook of methods in environmental studies, Vol. 2: Air, noise, soil, overburden, solid waste and ecology. ABD Publishers, Jaipur.
10. Mamata Tomar, Quality Assessment of Water and Waste Water, Lewis Publishers London
11. Marc Pansu, Jacques Gautheryrou, Hand book of soil analysis- Mineralogical, organic and inorganic methods, Springer, New York

 <p>The logo of Mahatma Gandhi University is circular, featuring a central geometric design with a wheel-like structure. The text 'MAHATMA GANDHI UNIVERSITY' is written around the top inner edge, and 'KOTTAYAM' is at the bottom. Below the circle is a banner with the Sanskrit motto 'विद्यया अमृतमपश्यत्'.</p>	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the course : ES M21 C16 Lab Course II</b>


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13. Miroslav Radojevic and Vladimir N Bashkin, Practical Environmental Analysis, RSC Publishing.
14. NEERI ,Air quality monitoring, A course manual (Photostat), NEERI Nagpur
15. Samantha, L. and Andrew, L. 2015. Practical Handbook of Remote Sensing. Routledge, Taylor and Francis.

	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the course : ES M21 E 17</b> <b>Ecotoxicology</b>

<b>School Name</b>	School of Environmental Sciences						
<b>Programme</b>	M.Sc. Environment Science and Management						
<b>Course Name</b>	Ecotoxicology						
<b>Type of Course</b>	Elective						
<b>Course Code</b>	ES M21 E17						
<b>Names of Academic Staff &amp; Qualifications</b>	Dr. Mahesh Mohan, MSc., PhD						
<b>Course summary &amp; Justification</b>	The course's major goal is to provide students with the knowledge and skills necessary to assess the destiny of pollutants in the environment and their impacts on various biological organisation levels. To that goal, the conceptual framework established throughout the ecotoxicology course will be expanded and applied.						
<b>Semester</b>		<b>2</b>	<b>Semester</b>			<b>2</b>	
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>	
						<b>40</b>	
<b>Pre-requisite</b>							

<b>CO No.</b>	<i>At the end of the course, the student will be able to:</i>	<b>Taxonomic Level (TL)</b>	<b>PSO</b>
<b>1</b>	Describe sources and fates of chemicals in the environment	R	2



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	<b>Name of the course : ES M21 E 17 Ecotoxicology</b>

<b>2</b>	Explain mechanisms for adverse effects of chemicals	U	2,3
<b>3</b>	Estimate the risk for adverse effects of a chemical on different biological organisation levels based on knowledge about the toxicity, degradability, and bioavailability of the chemical	E	2
<b>4</b>	Do toxicological testing of environmental pollutants	Ap	3
<b>5</b>	Explain the significance of sanitation and carryout awareness on awareness on sanitation and health	E,Ap	2,3
<b>6</b>	Explain food security in terms of contamination of food and control measures	A	2
<b>7</b>	Explain the toxicokinetics and toxicodynamics	Ap	2


Unit	Course Description	Hours	CO No.
<b>1</b>	<b>Toxicants and ecosystem</b>		
1.1	Toxicants – organic and inorganic	<b>1</b>	<b>1,7</b>
1.2	Toxicants – entry into the environment, cycles and residence time	<b>2</b>	<b>1</b>
1.3	Transboundary movement of pollutants- factors affecting	<b>1</b>	<b>1</b>
1.4	Global environmental pollutants	<b>2</b>	<b>1</b>
1.5	Routes of exposure to humans – food, occupation, environment	<b>3</b>	<b>2</b>
<b>2</b>	<b>Toxicants and their effects</b>		
2.1	Effects of toxicants on populations and communities	<b>2</b>	<b>2</b>
2.2	Toxicity of pesticides, metals, radioactive minerals, fluorides, chemical fertilizers and air pollutants – cellular and molecular level	<b>2</b>	<b>2,7</b>



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**Name of the course : ES M21 E 17  
Ecotoxicology**

2.3	Damage process and action of toxicants – exposure, uptake, transport, storage, mechanism of action in plants and mammals	<b>2</b>	<b>2,7</b>
2.4	Toxicants in the food chain- Accumulation and magnification Multilevel trophic interactions and non-trophic interactions	<b>1</b>	<b>2,3</b>
2.5	Acute and chronic effects	<b>1</b>	<b>2,3</b>
2.6	Occupational hazards and diseases	<b>2</b>	<b>2,3</b>
2.7	Toxicity of biohazards	<b>1</b>	<b>2,3</b>
<b>3</b>	<b>Toxicity testing and indicators</b>		
3.1	Principles of toxicity testing, Factors to be considered in toxicity testing	<b>2</b>	<b>4</b>
3.2	Methods of toxicity evaluation at cellular and molecular level by in vitro and in vivo methods	<b>1</b>	<b>4</b>
3.3	Ecotoxicological testing methods – single species testing, microcosms etc.	<b>2</b>	<b>4</b>
3.4	Bioindicators , lacustrine communities as indicators of ecosystem stress Biosensors– concept and approach Biomarkers- classification, relationship of biomarkers to adverse effects	<b>2</b>	<b>3,4</b>
<b>4</b>	<b>Sanitation, Health and Hygiene</b>		
4.1	Sanitation and Health- introduction and Current situation	<b>2</b>	<b>5</b>
4.2	Water and sanitation related diseases, respiratory infections, under nutrition	<b>2</b>	<b>3,5</b>
4.3	Successful approaches to sanitation-strategies Role of health sector	<b>2</b>	<b>5</b>

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	<b>Name of the course : ES M21 E 17 Ecotoxicology</b>


	Global experience in improving sanitation and hygiene		
4.4	Climate change and diseases Epidemiology and health ecology Epidemiological diseases due to pollution problems	<b>1</b>	<b>3,5</b>
	Health effects of cosmetics and drugs Health risk assessment of toxic chemicals Ecological risk assessment	<b>2</b>	<b>3,5</b>
<b>5</b>	<b>Food Security</b>		
5.1	Concept of food security, food systems and public health	<b>1</b>	<b>6</b>
5.2	Interrelation between diet, food production, the environment, population and resources	<b>1</b>	<b>6</b>
5.3	Toxicants in food	<b>2</b>	<b>2,6</b>

Teaching and Learning Approach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning (Video), interactive Instruction: Active co-operative learning, Seminars, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative.
Assessment Types	<ol style="list-style-type: none"> <li>1. Continuous Internal Assessment (CIA) <ul style="list-style-type: none"> <li>Internal test</li> <li>Review of Book /Article</li> <li>Seminar Presentation</li> <li>Field visit report</li> </ul> </li> <li>2. Semester End examination</li> </ol>

	<b>MAHATMA GANDHI UNIVERSITY</b>
<b>Name of the course : ES M21 E 17</b> <b>Ecotoxicology</b>	


## References

1. Ballantyne, B., Marris, T. and Turner, P. (Ed.). 1995. General and applied toxicology (Abridged edition), Macmillan Press
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5. Grosby DG. 1998. Environmental toxicology and chemistry, Oxford University Press
6. Levy B.S. and Wegman D.H. (Ed.). 1995. Occupational health- recognizing and preventing work related disease. Little Brown and Co.
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10. Richardson M. 1995. Environmental Toxicity assessment. Taylor and Francis Ltd.
11. Stine K.E. and Brown T.M. 1996. Principles of toxicology.
12. Wright D.A. and Welbourn P. 2002. Environmental Toxicology, Cambridge University Press.
13. Yu M. 2001. Environmental toxicology-impacts of environmental toxicants on living system, Lewis Publishers.

	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the course : ES M21 E 18</b> <b>Green Chemistry and Nano Technology</b>


<b>School Name</b>	School of Environmental Sciences						
<b>Programme</b>	M.Sc. Environment Science and Management						
<b>Course Name</b>	Green Chemistry and Nano Technology						
<b>Type of Course</b>	Elective						
<b>Course Code</b>	ES M21 E 18						
<b>Names of Academic Staff &amp; Qualifications</b>	<b>Dr.C.T.Aravindakumar , PhD</b> <b>Dr. E.V.Ramasamy , M.Tech., Ph.D</b>						
<b>Course summary &amp; Justification</b>	<b>Course Summary:</b> Provides an overview of nano technology and its application in solving environmental issues. <b>Justification :</b> As nano technology is an emerging domain of knowledge with lots of applications in Environmental Science this course is an appropriate elective for Environment management students.						
<b>Semester</b>		<b>2</b>	<b>Credit</b>			<b>2</b>	
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>	
						<b>40</b>	
<b>Pre-requisite</b>							

<b>CO No.</b>	<b>At the end of the course, the student will be able to:</b>	<b>Taxonomic Level (TL)</b>	<b>PSO</b>
<b>1.</b>	Explain green chemistry	R	2,3
<b>2</b>	Describe the applications of green chemistry	U	2,3
<b>3.</b>	Describe green synthesis	R, U	2,3

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	<b>Name of the course : ES M21 E 18 Green Chemistry and Nano Technology</b>


4.	Explain Green technologies for waste management	R, U	3,5
5.	Explain nanotechnology for environmental benefits	R	2,3,5
6.	Explain green synthesis of nanoparticles and their characterization.	R, U	3,5
7.	Apply the nano technology in environmental monitoring and remediation.	U, A	3,5

Unit	Course Description	Hours	CO No.
<b>1</b>	<b>Introduction to Green chemistry</b>		
1.1	Introduction and need for green chemistry	3	1
1.2	Principles of green chemistry	3	1
1.3	Percentage atom utilization and percentage atom economy; rearrangement, addition, substitution and elimination reactions; examples of catalytic reactions	4	1, 2
<b>2</b>	<b>Green synthesis</b>		
2.1	Planning green synthesis; evaluation of rearrangement, addition, substitution, elimination and pericyclic reactions for green reactions;	4	3
2.2	Selection of solvents; selection of starting materials; use of protecting groups; use of catalyst and low energy reactions	3	3
<b>3</b>	<b>Alternate approach to solvent chemistry</b>		<b>2,3</b>
3.1	solvent free reactions; microwave assisted synthesis; ionic liquids as an eco-friendly solvent	3	2,3
3.2	supercritical fluid extraction as a cleaner technology	2	2,3
<b>4</b>	<b>Green technologies</b>		

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	<b>Name of the course : ES M21 E 18 Green Chemistry and Nano Technology</b>

4.1	catalytic reactions; alternate waste treatment technologies: Advanced Oxidation Technologies for waste water treatment , Phycoremediation, Sustainable sanitation	<b>6</b>	<b>4</b>
<b>5</b>	<b>Introduction to nanotechnology</b>	<b>6</b>	
5.1	Particle size, surface area and quantum dots ; synthesis and fabrication – nano scale metal oxides, Carbon nanotubes , nanocomposites., Green nanosynthesis- types , methods and advantages; nanotechnology as a tool for sustainability, health and safety.		<b>5</b>
<b>6</b>	<b>Characterization and applications of nano particles</b>	<b>6</b>	
6.1	Characterization of nano particles for structural and chemical nature. Environmental applications of nano materials –ground water remediation, water purification, absorbent, membrane process, Nano sensors, detection of pesticides and trace metal ions, environmental monitoring, social implications of nanoscience and technology.		<b>5</b>


Teaching and Learning Approach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning (Video), interactive Instruction: Active co-operative learning, Seminars, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative.
Assessment Types	<p>A. Continuous Internal Assessment (CIA)</p> <ul style="list-style-type: none"> <li>• Assignments</li> <li>• Seminar Presentation on selected topics</li> <li>• Quiz</li> <li>• Class tests</li> </ul> <p>B. Semester End examination</p>

	<b>MAHATMA GANDHI UNIVERSITY</b>
<b>Name of the course : ES M21 E 18 Green Chemistry and Nano Technology</b>	

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	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the course : ES M21 E 18 Green Chemistry and Nano Technology</b>

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**MAHATMA GANDHI UNIVERSITY**

**Name of the Course : ES M21 E 19  
Fundamentals of Management**

<b>School Name</b>	<b>School of Environmental Sciences</b>						
<b>Programme</b>	<b>M.Sc. Environment Science and Management</b>						
<b>Course Name</b>	<b>Fundamentals of Management</b>						
<b>Type of Course</b>	<b>Elective</b>						
<b>Course Code</b>	<b>ES M21 E 19</b>						
<b>Names of Academic Staff &amp; Qualifications</b>	<b>Dr. C.T. Aravindakumar , MSc., PhD</b>						
<b>Course summary &amp; Justification</b>	The fundamental principles and procedures of management are covered in this course. The core functions and procedures of planning, leading, organising, and controlling that form the manager's position will be examined by students. The logic and operation of organisations are examined in this subject. The content of the course is organised around the four 'pillars' of management, namely planning, organising, leading, and controlling [POLC], to provide a systematic understanding of management-related challenges and to apply conceptual tools and techniques in analysing, evaluating, and addressing management issues.						
<b>Semester</b>		<b>1</b>	<b>Semester</b>			<b>1</b>	
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>	
						<b>40</b>	
<b>Pre-requisite</b>							




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**Name of the Course : ES M21 E 19  
Fundamentals of Management**

<b>CO No.</b>	<b><i>At the end of the course, the student will be able to:</i></b>	<b>Taxonomic Level (TL)</b>	<b>PSO</b>
1.	Explain factors that contribute to management evolution	R	1, 9
2	Analyse and assess the influence of historical forces on current management strategies.	A	1,9,10
3.	Identify and analyse social responsibility and ethical issues that arise in corporate circumstances, and communicate your personal position on these topics coherently.	Ap	10
4.	Explain how businesses adapt to a changing environment and suggest management approaches for influencing and controlling the internal environment.	U	9, 10
5.	Develop the process of management's four functions: planning, organizing, leading, and controlling	Ap	9
6.	Interpret and properly use vocabularies within the field of management to articulate one's own position on a specific management issue and communicate effectively with varied audiences.	U	8,9
7.	Identify the areas to control and Selecting the Appropriate controlling methods/Techniques	E	7

<b>Unit</b>	<b>Course Description</b>	<b>Hours</b>	<b>CO No.</b>
1	Introduction to Management:	1	1
1.1	Nature and Scope, Functions, Managerial Roles,	3	1,7
1.2	Management levels, Managerial Skills, Challenges of Management;	3	1,2
1.3	Evolution of Management- Classical Approach, The Behavioural approach; The Quantitative approach; The Systems Approach; Contingency Approach, IT Approach.	3	1,6

	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the Course : ES M21 E 19 Fundamentals of Management</b>

<b>2</b>	<b>Planning and Decision Making:</b>		
2.1	Framework for Planning – Process and Types of Plans,	<b>3</b>	<b>1,2</b>
2.2	Management by Objectives; Decision making and Problem Solving - Programmed and Non Programmed Decisions	<b>2</b>	<b>1,2</b>
2.3	Steps in Problem Solving and Decision Making; Bounded Rationality and Influences on Decision Making;	<b>3</b>	<b>1,2</b>
	Group Problem Solving and Decision Making, Creativity and Innovation in Managerial Work.	<b>3</b>	<b>1,2</b>
<b>3</b>	<b>Organization and HRM:</b>		
3.1	Principles of Organization: Organizational Design & Structures;	<b>3</b>	<b>3</b>
3.2	Departmentalization, Delegation; Empowerment, Centralization, Decentralization, Recentralization;	<b>2</b>	<b>3,5</b>
3.3	Organizational Culture; Organizational Climate and Organizational Change.	<b>2</b>	<b>3,4,7</b>
3.4	Human Resource Management	<b>2</b>	<b>5,7</b>
<b>4</b>	<b>Leading and Motivation:</b>		
4.1	Leadership Styles; Behavioural Leadership, Situational Leadership,	<b>4</b>	<b>3,5</b>
4.2	Leadership Skills, Leader as Mentor and Coach, Leadership during adversity and Crisis;	<b>3</b>	<b>3</b>
4.3	Team Motivation - Types of Motivation	<b>3</b>	<b>4</b>

	<b>MAHATMA GANDHI UNIVERSITY</b>
<b>Name of the Course : ES M21 E 19</b> <b>Fundamentals of Management</b>	

<b>Teaching and Learning Approach</b>	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning (Video), interactive Instruction: Active co-operative learning, Seminars, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative.
<b>Assessment Types</b>	<ol style="list-style-type: none"> <li>1. Continuous Internal Assessment (CIA)           <ul style="list-style-type: none"> <li>Internal test</li> <li>Review of Book /Article</li> <li>Seminar Presentation</li> <li>Field visit report</li> </ul> </li> <li>2. Semester End examination</li> </ol>

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**MAHATMA GANDHI UNIVERSITY**

**Name of the Course : ES M21 E 20  
Environmental Microbiology**

<b>School Name</b>	School of Environmental Sciences					
<b>Programme</b>	<b>M.Sc. Environment Science and Management</b>					
<b>Course Name</b>	<b>Environmental Microbiology</b>					
<b>Type of Course</b>	<b>Elective</b>					
<b>Course Code</b>	ES M21 E 20					
<b>Names of Academic Staff &amp; Qualifications</b>	<b>Dr. Harsha HT, Mrs. Anuthara R.</b>					
<b>Course summary &amp; Justification</b>	The goal of this course is to give students a basic understanding of environmental microbiology, including the functional diversity of microorganisms in the environment and how it affects human welfare and ecosystem health, microbial interactions with pollutants in the environment, and microbial pathogens' fate in the environment. Microbial habitats, identification of microorganisms and their activities in the environment, microbial biogeochemistry, bioremediation, and water quality are among the topics discussed.					
<b>Semester</b>		<b>2</b>	<b>Credit</b>			<b>2</b>
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>
		<b>30</b>	<b>5</b>		<b>5</b>	<b>40</b>
<b>Pre-requisite</b>						
<i>Others- Case studies , Library, seminar and assignment preparations, test, research article/ case reports discussion etc.</i>						

<b>CO No.</b>	<b>At the end of the course, the student will be able to:</b>	<b>Taxonomic Level (TL)</b>	<b>PSO No</b>
<b>1</b>	Various microorganisms in the environment with their basic characteristics	R	1,2
<b>2</b>	Understand and apply the various techniques for the isolation and characterization of microorganisms from environmental compartments	U, A	3, 5




**MAHATMA GANDHI UNIVERSITY**

**Name of the Course : ES M21 E 20  
Environmental Microbiology**

<b>3</b>	Understand and evaluate the role of microorganisms in various biogeochemical cycles and other environmental processes	U, E	3, 5
<b>4</b>	Understand and analyse the role of microorganism in various diseases	U	5, 7
<b>5</b>	Analyse and apply the role of microorganisms in various environmental applications	A, Ap	5, 7

<b>Unit</b>	<b>Course Description</b>	<b>Hours</b>	<b>CO No.</b>
<b>1</b>	<b>Microorganisms in the environment</b>	<b>10</b>	<b>1</b>
1.1	Introduction, scope and brief history	1	1
1.2	Microorganisms in the environment– bacteria, fungi, protists, algae and viruses - characteristic features and their role in the environment	3	1
1.3	Morphology and the basic structure of bacteria - plasma membrane, cell wall, flagella , pili, capsule, slime layer, glycolcalyx, nucleoid, ribosomes, cytoplasmic inclusions	2	1
1.4	Microbial habitat in air, water and soil	3	1
1.5	Basics of Gram staining	1	1
<b>2</b>	<b>Isolation and characterisation of bacteria from the environment</b>	<b>8</b>	<b>1, 2</b>
2.1	Pour plate and streak plate method. Use of different media and culture techniques.	2	1, 2
2.2	Pure culture techniques – streak plate method – quadrant streak and continuous streak methods. Maintenance of bacteria on agar slants and long term preservation as glycerol stock.	2	1, 2
2.3	Outline of microbial taxonomy – phenetic and phylogenetic classification. Bergey’s manual of determinative bacteriology	2	2
2.4	PCR technique - Principles and applications	2	2
<b>3</b>	<b>Microorganisms and environmental processes</b>	<b>8</b>	<b>1, 2,3, 5</b>
3.1	Role of microorganisms in biogeochemical cycles with special reference to carbon, nitrogen, phosphorus and sulphur cycles	2	1, 3
3.2	Microorganisms in extreme environments – Archaeobacteria – Psychrophiles, Thermophiles, Halophiles, Barophiles, Methanogenes etc.	2	1,3
3.3	Soil microbial communities and their association with plants – bipartite and tripartite associations - rhizosphere microflora,	3	2, 3

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	<b>Name of the Course : ES M21 E 20 Environmental Microbiology</b>


	mycorrhizae – ecto and endomycorrhizae – VAM – actinorrhizae		
3.4	Role of microorganisms in biological transformation of pollutants	1	2, 5
<b>4</b>	<b>Microorganisms and disease</b>	<b>7</b>	<b>3, 4</b>
4.1	Water and air borne pathogens	2	3,4
4.2	Diseases caused by microorganisms and their symptoms – routes of infection and control measures.	3	3,4
4.3	Microbial indicators of water quality – coliforms, faecal coliforms, <i>Escherichia coli</i> and faecal streptococci.	2	3,4
<b>5</b>	<b>Applications of microorganisms in environment management</b>	<b>7</b>	<b>1, 2, 5</b>
5.1	Waste water treatment	2	1, 5
5.2	Application of genetically engineered organisms in the clean-up of the environment	2	1,5
5.3	Role of microorganisms in bioremediation	2	2,5
5.4	Pollutant-microbe interactions – metal-microbe interactions	1	5

Teaching and Learning Approach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning (Video), interactive Instruction:, Active co-operative learning, Seminars, Group Assignments Authentic learning, , Library work and Group discussions
Assessment Types	A. Continuous Internal Assessment (CIA) <ol style="list-style-type: none"> <li>1. Internal test</li> <li>2. Review of Book /Article</li> <li>3. Seminar Presentation</li> <li>4. Field visit report</li> </ol> B. Semester End examination

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 <p>MAHATMA GANDHI UNIVERSITY KOTTAYAM</p> <p>विद्या अमृतममृतम्</p>	<p style="text-align: center;"><b>MAHATMA GANDHI UNIVERSITY</b></p> <hr/> <p style="text-align: center;"><b>Name of the Course : ES M21 E 20</b> <b>Environmental Microbiology</b></p>
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## **SEMESTER III**

	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of course : ES M21 C 21 Environmental Management</b>

<b>School Name</b>	<b>School of Environmental Sciences</b>					
<b>Programme</b>	<b>M.Sc.</b>					
<b>Course Name</b>	<b>Environmental Management</b>					
<b>Type of Course</b>	Core					
<b>Course Code</b>	ES M21 C 21					
<b>Course Summary &amp; Justification</b>	This course allows the students to learn the fundamentals theories and concepts of Environment Management.					
<b>Semester</b>	2		<b>Credit</b>			3
<b>Total Student Learning Time (SLT)</b>	Learning Approach	Lecture	Tutoria 1	Practica 1	Other s	Total Learning Hours
	Authentic learning Collaborative learning Case based learning	40	5	-	5	60
<b>Pre-requisite</b>	As per the requirement of the course					
<i>Others- Case studies , Library, seminar and assignment preparations, test, research article/ case reports discussion etc.</i>						

### **COURSE OUTCOMES (CO)**

<b>CO No.</b>	<b>Expected Course Outcome</b>	<b>Learning Domains</b>	<b>PSO</b>
	<i>Upon completion of this course, students will be able to;</i>		
1	Understand the basic concepts of Environment Management	U	1, 2
2	Understand and evaluate the fundamental concepts of ecosystem management	U, E	2,6,9
3	Understand and analyse the fundamental concepts of	U, An	1, 2, 9, 10



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Name of course : ES M21 C 21  
Environmental Management

	environmental planning and Management with various standards		
4	Explain and apply the application of environmental planning and management in managing disasters	U, A	2,4,6,9,10
5.	Explain and apply the ecosystem restoration in environment management	U, A	2,4,6,9,10
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

### COURSE CONTENT


		Hrs	CO. No.
<b>Unit 1: Introduction</b>		12 Hrs	
1.1	Basic Principles of Environmental Management	2	1
1.2	Environmental management – tools and techniques	2	1,2
1.3	Environmental Management Systems (EMS)	2	1,2, 3
1.4	Introduction to environmental quality models- input and output models, linear programming models of environmental quality management	2	1,2
1.5	Natural resources and their management	4	1, 2
<b>Unit 2: Environmental Management Systems (EMS)</b>		16 Hrs	
2.1	International standards for Environmental Management	4	1,3
2.2	ISO 14000 Family Standards	4	1,3
2.3	Other Environmental Standards - ISO 9001, ISO 14001, ISO 45001, ISO 50001, ISO 20121 etc.	6	1,3
2.3	EMS in industries	2	1,3
<b>Unit 3: Environmental Planning and Management (EPM)</b>		12 Hrs	



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**Name of course : ES M21 C 21  
Environmental Management**

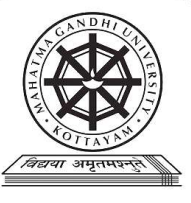
3.1	Principles of EPM	2	1, 3
3.2	Concepts and scope of environmental planning	2	1, 3
3.3	Ecological aspects of EPM	2	1, 3
3.4	Steps in Environmental planning	1	1, 3
3.5	Identification and formulation of strategies of EPM	1	1, 3
3.6	Environmental analysis and EPM	1	1, 3
3.7	Physical planning in relation to environmental and land use classification : EPM for Town and urban lands, Rural and agricultural lands, Waste lands, Lands reclaimed, Wetlands, Mining areas, Industrial areas, Transportation and urban planning	3	1, 3 ,4,
<b>Unit 4:EPM for Environmental Hazards</b>		<b>9 hrs</b>	
4.1	Environmental hazards and EPM	2	1, 3,4
4.2	Types of environmental hazards- Food, drought, landslides, earthquakes, cyclones etc.	3	1, 3,4
4.3	Significance and characteristics of hazards in environmental planning and development	2	1, 3,4
4.4	Opportunities and regional planning for hazard management	2	1, 3,4
<b>Unit 5:Restoration of Ecosystems</b>		<b>15hrs</b>	
5.1	Eco restoration- definition & history & significance	3	1, 5
5.2	Degraded ecosystems – reasons – natural and anthropogenic	3	1,2, 5
5.3	Restoration types – active and passive	4	1, 5
5.4	Restoration process – pre-analysis, process and past monitoring	10	1,2, 5
5.5	Global and regional initiatives	6	1, 5

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	<b>Name of course : ES M21 C 21 Environmental Management</b>

<b>Teaching and Learning Approach</b>	<b>Classroom Procedure (Mode of transaction)</b> Authentic learning, case-based learning, collaborative learning, seminar, group activities.
<b>Assessment Types</b>	<b>Mode of Assessment</b> 4. Continuous Internal Assessment (CIA) 5. Seminar Presentation – 6. Assignments B. Semester End examination

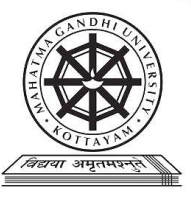
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	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the course : ES M21 C 22</b> <b>Environmental Engineering</b>

<b>School Name</b>	School of Environmental Sciences					
<b>Programme</b>	<b>M.Sc. Environment Science and Management</b>					
<b>Course Name</b>	Environmental Engineering					
<b>Type of Course</b>	<b>Core</b>					
<b>Course Code</b>	ES M21 C 22					
<b>Names of Academic Staff &amp; Qualifications</b>	<b>Dr. E.V.Ramasamy, M.Tech., Ph.D</b>					
<b>Course summary &amp; Justification</b>	<p><b>Course Summary:</b> Application of Environmental Engineering principles in Air, Water resources and Solid Waste Management. The course has been designed with very essential components of Engineering concepts so that the science graduates can understand and appreciate the course. The last unit provides a brief insight in to the Industrial Risk Assessment techniques.</p> <p><b>Justification :</b> As mentioned above this course is aimed to train science graduates with essential inputs from (Environmental) Engineering so that a capacity building can be attained among the students in order equip them to face the job market.</p>					
<b>Semester</b>		<b>3</b>	<b>Credit</b>			<b>3</b>
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>
						<b>54</b>
<b>Pre-requisite</b>						

<b>CO No.</b>	<b>At the end of the course, the student will be able to:</b>	<b>Taxonomic Level (TL)</b>
<b>1.</b>	Understand air and water resource management, solid waste management through the concept of System approach. Describe the basics of mass balance analysis in Environmental Engineering	U, R, A
<b>2</b>	Understand various steps and techniques of water and wastewater	U,A,E

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	<b>Name of the course : ES M21 C 22</b> <b>Environmental Engineering</b>

	treatment. Apply system approach in water resource management.	
<b>3.</b>	Describe air quality standards. To understand meteorological factors in air pollution and apply theories and models in air pollution / emission dispersion.	U,A
<b>4</b>	Understand different air pollution control techniques.	U,E,R
<b>5</b>	Explain the importance of Solid waste Management with the concept of system approach. Evaluate various techniques in solid waste processing and disposal.	U, R,C
<b>6</b>	Understand noise pollution concept, analyse the ambient noise level; Describe the risks associated with industries and analyse the risk using various risk analytical techniques	U,A,R,E

<b>Unit</b>	<b>Course Description</b>	<b>Hours</b>	<b>CO No.</b>
<b>1</b>	<b>Introduction</b>	<b>4</b>	
1.1	Environmental Engineering and Environmental Systems: Water resource management; air resource management	2	<b>1</b>
1.2	Solid waste management systems	1	<b>1,2</b>
1.3	Mass-balance approach to problem solving.	1	<b>2,3</b>
<b>2</b>	<b>Water Resource Management: Water and Wastewater Treatment</b>	<b>16</b>	
2.1	Water quality studies: Sampling technique, Sampling devices, Sample preservation, Physical – Chemical and biological examination of water , Water quality standards	2	<b>1,3</b>
2.2	Water treatment - Filter plants : Mixing and flocculation, Coagulation, Jar test; Softening – lime soda and ion exchange process ; Filtration – slow, rapid and high – rate sand filters; Disinfection – Chlorination, Ozonation and UV application	6	<b>2,3</b>
2.3	Wastewater treatment : Municipal sewage treatment - Basic treatment processes and flow- sheets, Waste flow rates and their assessment;	8	<b>2,3</b>

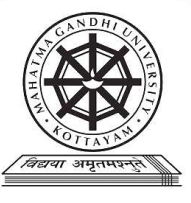




**MAHATMA GANDHI UNIVERSITY**

**Name of the course : ES M21 C 22  
Environmental Engineering**

	<p>Unit operations of pre-treatment and primary treatment - Bar racks, grit chambers, communitors, equalization and sedimentation, Design concepts.</p> <p>Secondary treatment: Biological unit processes - Nature and kinetics of biological growth; Aerobic activated sludge process and its various modification; Oxidation ponds; Attached growth systems – trickling filters, Rotating biological contactors (RBCs).</p> <p>Anaerobic wastewater treatment systems: Evolution of high – rate anaerobic reactors – CSTRs; Up flow anaerobic filters (UAFs); UASBs, Expanded / Fluidised bed reactors.</p> <p>Chemical unit process: Precipitation, Coagulation, Disinfection.</p> <p>Tertiary / Advanced treatment system: Filtration; Adsorption; Nitrogen and phosphorous removal; Biological nutrient removal (BNR) system.</p> <p>Land treatment – Slow rate, overland flow, rapid infiltration</p>		
<b>3</b>	<b>Air Resource Management: Air quality studies</b>	<b>8</b>	
3.1	Air quality standards : Micro and macro air pollution ; Indoor air pollution ; Acid rain ; Ozone depletion ; Greenhouse effect	2	<b>2,3</b>
3.2	Air pollution meteorology : The atmospheric engine ; Turbulence, stability, laps rate, plume behaviour, terrain effects ; Factors affecting dispersion of air pollutants ; Dispersion modeling – Gaussian dispersion model	6	<b>2,3</b>
<b>4</b>	<b>Air Resource Management: Air Pollution Control</b>	<b>8</b>	
4.1	Control of particulate matter : Gravitational ; Centrifugal; Electrostatic, fabric and wet collectors	2	<b>3,4</b>
4.2	Control of gaseous contaminants : Adsorption ; Absorption; Condensation ; Combustion	4	<b>4</b>
4.3	Automobile emission control	2	<b>4</b>
<b>5</b>	<b>Solid Waste Management: Municipal Solid Waste</b>	<b>12</b>	
5.1	Types, sources and properties	1	<b>4, 5</b>
5.2	Techniques for treatment / processing of solid waste :	6	

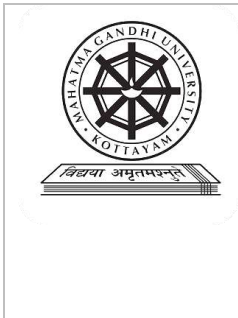
	<b>MAHATMA GANDHI UNIVERSITY</b>
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	Recovery, reclamation, recycle and reuse of resources		
5.3	Disposal methods for the solid waste residues : Incineration ; Sanitary land fills	3	
5.4	Hazardous waste management	2	
<b>6</b>	<b>Noise Pollution and Risk Assessment</b>	<b>6</b>	
6.1	Noise pollution		
6.2	Noise levels, measurements and noise limits	1	
6.3	Noise attenuation and control measures	1	
6.4	Risk assessment and disaster management for industries : Case histories of major chemical disasters; Basic components of hazard control system; Technique of risk assessment – PHA, HAZOP, MAXCRED; Emergency control and disaster plan.	4	

Teaching and Learning Approach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning (Video), interactive Instruction: Active co-operative learning, Seminars, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative.
Assessment Types	<ol style="list-style-type: none"> <li>1. Continuous Internal Assessment (CIA) <ul style="list-style-type: none"> <li>• Assignments</li> <li>• Seminar Presentation on selected topics</li> <li>• Quiz</li> <li>• Tutorials</li> <li>• Class tests</li> </ul> </li> <li>2. Semester End examination</li> </ol>

## References


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Environmental Engineering**


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 <p>MAHATMA GANDHI UNIVERSITY KOTTAYAM</p> <p>विद्यया अमृतमपन्नम्</p>	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the course : ES M21 C 22 Environmental Engineering</b>

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21. Singh, R. 2015. Membrane technology and engineering for water purification: application, system design, and operation, Elsevier Publisher
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	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the course : ES M21 C 23 Environmental Impact Assessment</b>

<b>School Name</b>	<b>School of Environmental Sciences</b>						
<b>Programme</b>	<b>M.Sc. Environment Science and Management</b>						
<b>Course Name</b>	<b>Environmental Impact Assessment</b>						
<b>Type of Course</b>	<b>Elective</b>						
<b>Course Code</b>	<b>ES M21 C 23</b>						
<b>Names of Academic Staff &amp; Qualifications</b>	<b>Dr. Mahesh Mohan , MSc., PhD</b>						
<b>Course summary &amp; Justification</b>	The course is designed to teach students about Environmental Impact Assessment (EIA) and how it applies to various sorts of development projects. Students will be familiar with the standard procedure for conducting EIA studies for various governmental and non-governmental organisations. The course will also help students to understand and carry out the environmental auditing and life cycle assessment.						
<b>Semester</b>		<b>2</b>	<b>Semester</b>			<b>2</b>	
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>	
						<b>60</b>	
<b>Pre-requisite</b>							


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	<b>Name of the course : ES M21 C 23 Environmental Impact Assessment</b>

<b>CO No.</b>	<b><i>At the end of the course, the student will be able to:</i></b>	<b>Taxonomic Level (TL)</b>	<b>PSO</b>
<b>1</b>	Describe the global changes and sustainability	R	2,9
<b>2</b>	Explain the EIA process, LCA, Environmental audit	R, U	2,6,8,9
<b>3</b>	Explain the role of various agencies in EIA	R	2,6,9
<b>4</b>	Assess the project impacts and role of public participation in EIA	E	2,6,9
<b>5</b>	Do EIA using various methodologies	Ap	6,8,9
<b>6</b>	Do Environmental Audit	Ap	6,8,9
<b>7</b>	Explain the LCA and EMS	U	6,8,9

<b>Unit</b>	<b>Course Description</b>	<b>Hours</b>	<b>CO No.</b>
<b>1</b>	<b>Development projects and sustainability</b>		
1.1	Developmental Projects – types and proponents	<b>1</b>	<b>1</b>
1.2	Global changes and concept of Sustainability	<b>3</b>	<b>1</b>
1.3	Factors affecting sustainability	<b>1</b>	<b>1</b>
1.4	Efforts in achieving sustainability	<b>3</b>	<b>1</b>
1.5	Environment Management Techniques for Sustainable Development	<b>2</b>	<b>1</b>


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<b>2</b>	<b>Environmental Impact Assessment</b>		
2.1	Definition, aim, history, principles and concepts and scope	<b>2</b>	<b>2</b>
2.2	EIA steps	<b>3</b>	<b>2</b>
2.3	Types of EIA	<b>2</b>	<b>2</b>
2.4	Public participation in EIA- significance	<b>2</b>	<b>2</b>
2.5	EIA – history and notifications in India	<b>2</b>	<b>2</b>
2.6	EIA in India – organizational structure	<b>2</b>	<b>2,3</b>
<b>3</b>	<b>Environmental Impacts</b>		
3.1	Positive and negative impacts Primary and Secondary impacts Impact on physical, social and biotic environments	<b>3</b>	<b>4</b>
3.2	Baseline evaluation	<b>2</b>	<b>2,4</b>
3.3	Alternatives and mitigation measures in EIA	<b>2</b>	<b>2,4</b>
3.4	Terms of reference	<b>2</b>	<b>2,4</b>
<b>4</b>	<b>Environmental Impact Assessment methods</b>		
4.1	EIA Methods and their functions	<b>2</b>	<b>4,5</b>
4.2	Adhoc method, Checklist Method, Sectoral guidelines, Systematic sequential approach, Simulation modelling workshops, Spatial analysis methods, Rapid assessment techniques	<b>3</b>	<b>4,5</b>
4.3	Interaction Matrices- Network and Overlays Approach, Moore Impact matrix	<b>3</b>	<b>4,5</b>

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	<b>Name of the course : ES M21 C 23 Environmental Impact Assessment</b>

<b>5</b>	<b>EIA for different environmental programmes</b>		
5.1	Industries Urban development Mining	<b>3</b>	<b>2,4,5</b>
5.2	Energy projects : Hydel , Thermal, Nuclear, Oil and gas, Solar, Wind	<b>3</b>	<b>2,4,5</b>
5.3	EIA case studies	<b>2</b>	<b>2,4</b>
<b>6</b>	<b>Environment Audit</b>		
6.1	Introduction to environment audit-types; Environment auditor- auditing skills	<b>1</b>	<b>2,6</b>
6.2	Environment audit procedure – pre audit, site visit and post audit	<b>3</b>	<b>2,6</b>
6.3	Environmental auditing standards		<b>2,6</b>
<b>7</b>	<b>Life Cycle Assessment (LCA) and EMS</b>		
7.1	LCA – introduction , basics, objectives Life cycle stages, LCA components Global and regional impact categories LCA applications – case studies LCA and standards	<b>3</b>	<b>2,7</b>
7.2	Environment Management System (EMS)- introduction, structure, Procedure	<b>3</b>	<b>2,7</b>
7.3	LCA and EMS - Case studies	<b>2</b>	<b>2,7</b>




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	<b>Name of the course : ES M21 C 23 Environmental Impact Assessment</b>


Teaching and Learning Approach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning (Video), interactive Instruction:, Active co-operative learning, Seminars, Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative; Field work and field visits
Assessment Types	<ol style="list-style-type: none"> <li>1. Continuous Internal Assessment (CIA) <ul style="list-style-type: none"> <li>Internal test</li> <li>Review of Book /Article</li> <li>Seminar Presentation</li> <li>Field visit report</li> </ul> </li> <li>2. Semester End examination</li> </ol>

## References

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2. Glasson, J., Therivel, R and Chadwick, A. (1994). Introduction to Environmental Impact Assessment. UCI Press Ltd. London
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	<b>Name of the course : ES M21 C 23 Environmental Impact Assessment</b>


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	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the course : ES M21 C 24 Resource Management</b>

<b>School Name</b>	<b>School of Environmental Sciences</b>					
<b>Programme</b>	<b>M.Sc. Environmental Science and Management</b>					
<b>Course Name</b>	<b>Resource Management</b>					
<b>Type of Course</b>	Core					
<b>Course Code</b>	ES M21 C24					
<b>Course Summary &amp; Justification</b>	This course allows the students to learn the fundamentals theories and concepts of Environment Management.					
<b>Semester</b>	2			<b>Credit</b>		3
<b>Total Student Learning Time (SLT)</b>	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Case based learning	40	10	-	10	60
<b>Pre-requisite</b>	As per the requirement of the course					
<i>Others- Case studies , Library, seminar and assignment preparations, test, research article/ case reports discussion etc.</i>						

### COURSE OUTCOMES (CO)


CO No.	Expected Course Outcome	Learning Domains	PSO
	<i>Upon completion of this course, students will be able to;</i>		
1	Understand the basic concepts of Natural Resources	U	1, 2
2	Understand and evaluate the fundamental concepts of ecosystem management	U, E	2,6,9

	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the course : ES M21 C 24 Resource Management</b>


3	Analyse and evaluate the various strategies for water resource management	An, E	3, 6, 9, 10
4	Understand and analyse the management of various physical and biological resources	U, An	4,6,9,10
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

### COURSE CONTENT

		Hrs	CO. No.
<b>Unit 1 Natural resources</b>		<b>8 Hrs</b>	
1.1	Classification on the basis of recovery rate - Renewable and Non-renewable resources	1	1
1.2	origin-biotic and biotic resources	1	1
1.3	stages of development – potential, actual, reserve & stock	2	1
1.4	National international status of non-renewable resources	2	1
1.5	Status of extraction of natural resources- global and regional	2	1
<b>Unit 2: Ecosystem management</b>		<b>15 Hrs</b>	
2.1	Forest and Grassland management	6	1, 2, 4
2.2	Wetland Management	2	1, 2, 4
2.3	Management of Coastal and marine ecosystems	4	1, 2, 4
2.4	People’s participation in ecosystem management	3	1, 2, 4
<b>Unit 3: Water resource management</b>		<b>20 Hrs</b>	

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	<b>Name of the course : ES M21 C 24</b> <b>Resource Management</b>

3.1	Global Water Budget, global water availability, depletion of water resources , Interrelation of water resources with other natural resources and the environment	2	1,2, 3
3.2	Dams and water resources	2	2, 3
3.3	Basic Techniques for Water Analyses – Quality and Quantity	4	2, 3
3.4	Watershed management	4	2, 3
3.5	Irrigation water management	2	2, 3
3.6	Integrated Water Resources Management (IWRM)	2	2, 3
3.7	Concept of sustainable water resources development	2	2, 3
3.8	Global Efforts - water resource management, Local water organisations; World water organisations; UN, GWP, WWC, etc	2	2, 3
<b>Unit 4: Physical Resources</b>		<b>15 Hrs</b>	
4.1	Soil and mineral resources- status and significance, problems facing	2	2, 3,4
4.2	Soil quality management – engineering and ecological solutions	4	2, 3,4
4.3	Control of soil erosion	3	2, 3,4
4.4	Soil Management in Kerala	2	2, 3,4
4.5	Radioactive minerals and their management	2	2, 3,4
4.6	Metals and other minerals – management strategies	2	2, 3,4
<b>Unit 5: Biological Resources</b>		<b>10 Hrs</b>	
5.1	Forest resource management – NTFPs, biodiversity, medicinal plants	5	2, 3,4


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5.2	Integrated management of wild life population	3	2, 3,4
5.3	Sustainable Management of biological resources of Kerala	2	2, 3,4


<b>Teaching and Learning Approach</b>	<b>Classroom Procedure (Mode of transaction)</b> Authentic learning, case-based learning, collaborative learning, seminar, group activities.
<b>Assessment Types</b>	<b>Mode of Assessment</b> <ol style="list-style-type: none"> <li>1. Continuous Internal Assessment (CIA)</li> <li>2. Seminar Presentation</li> <li>3. Assignments</li> <li>4. Semester End examination</li> </ol>

### References

1. Abbasi, S.A. (2001) Water resources projects and their environmental impacts. Discovery publishing house, New Delhi.
2. Gangstad, I. (1990). Natural Resource management of water and land. Van Norstrand Reinhold, New york.
3. Petak, W.J and Atkisson, A.A. (1982). Natural Risk Hazard Assessment and Public policy. Springer- Verlag, New York.

	<b>MAHATMA GANDHI UNIVERSITY</b>
	<b>Name of the course : ES M21 C 25</b> <b>Lab Course III</b>


<b>School Name</b>	School of Environmental Sciences						
<b>Programme</b>	<b>M.Sc. Environment Science and Management</b>						
<b>Course Name</b>	<b>Lab Course III (RS &amp; GIS and Instrumental analysis)</b>						
<b>Type of Course</b>	<b>Core</b>						
<b>Course Code</b>	ES M21 C25						
<b>Names of Academic Staff &amp; Qualifications</b>	<b>Dr. Mahesh Mohan; Dr. Baiju K.R., Dr. Syllas V.P., Dr. Abin Varghese</b>						
<b>Course summary &amp; Justification</b>	The course will enable students to understand the instrumental analysis. The students will get hands on training on the sophisticated chromatographic and spectrometric equipment. The students will also get acquainted with the RS & GIS technique and become able do the Satellite processing and environmental application of GIS.						
<b>Semester</b>		<b>2</b>	<b>Semester</b>			<b>2</b>	
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>	
						<b>60</b>	
<b>Pre-requisite</b>							

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	<b>Name of the course : ES M21 C 25</b> <b>Lab Course III</b>


<b>CO No.</b>	<b><i>At the end of the course, the student will be able to:</i></b>	<b>Taxonomic Level (TL)</b>	<b>PSO</b>
<b>1</b>	Explain the basic principles of the analytical equipment	R	3,5,8
<b>2</b>	Do environmental analysis using spectroscopic and chromatographic techniques	Ap	3,5,8
<b>3</b>	Do air pollution Monitoring using online equipment	Ap	3,8
<b>4</b>	Explain the sample processing techniques for the instrumental analysis	U	3,8
<b>5</b>	Do satellite imagery processing	Ap	3,6
<b>6</b>	Assess environmental changes using GIS platform	Ap	3,6
<b>7</b>	Explain advanced methods in RS & GIS	U, Ap, An, E, C	3,6,8

<b>Unit</b>	<b>Course Description</b>	<b>Hours</b>	<b>CO No.</b>
<b>1</b>	<b>Spectroscopy</b>		
<b>1.1</b>	Spectrophotometer- UV, Vis, FTIR	<b>3</b>	<b>1,2,4</b>
<b>1.2</b>	ICP-MS	<b>3</b>	<b>1,2,4</b>
<b>1.3</b>	Mercury analyser – CVAAS, Direct Mercury Analyser, CVAFS	<b>3</b>	<b>1,2,4</b>
<b>2</b>	<b>Chromatography</b>		
<b>2.1</b>	LC	<b>3</b>	<b>1,2,4</b>



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	<b>Name of the course : ES M21 C 25</b> <b>Lab Course III</b>

2.2	IC	3	1,2,4
2.3	LC-MS, LC-QToF	3	1,2,4
2.4	GC-TCD,ECD,FID	3	1,2,4
2.5	GC-MS	3	1,2,4
<b>3</b>	<b>Other equipment &amp; Online monitoring instruments</b>		
3.1	TOC	2	1,2,4
3.2	Ambient Air Quality Monitoring System	2	3
3.3	Portable Water Quality Analyser	2	1,2,4
3.4	Portable Green House Gas analyser	3	1,2,4
<b>4</b>	<b>GIS</b>		
4.1	Creation of Digital Elevation Model, Understanding various freely available global DEMs	2	5,6,7
4.2	Raster Analysis in GIS ( 3D analysis tools- Line of sight, Line/ Area Elevation profile)	2	5,6,7
4.3	Generation of Slope, Aspect, Hill shade, View shed, Curvature	2	5,6,7
4.4	Reclassification and Ranking	2	5,6,7
4.5	Raster Calculator	1	5,6,7
4.6	Weighted Overlay analysis	3	5,6,7
4.7	Raster Interpolations (IDW, Kriging)	1	5,6,7
4.8	Weighted Overlay	1	5,6,7
	<b>RS&amp; Image processing</b>		
5.1	Understanding Geometric and Radiometric Errors	1	5,6,7


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	<b>Name of the course : ES M21 C 25 Lab Course III</b>

5.2	Geometric and Radiometric Corrections	2	5,6,7
5.3	Sub setting the Image	2	5,6,7
5.4	Visual Interpretation of satellite image	3	5,6,7
5.4	Digital Image Classification (Supervised/ Unsupervised)	3	5,6,7
5.5	Image Enhancement Techniques (EVI, NDVI)	2	5,6,7


Teaching and Learning Approach	Laboratory Practical
Assessment Types	<ol style="list-style-type: none"> <li>1. Continuous Internal Assessment (CIA) <ul style="list-style-type: none"> <li>Internal test</li> <li>Review of Book /Article</li> <li>Seminar Presentation</li> <li>Field visit report</li> </ul> </li> <li>2. Semester End examination</li> </ol>

## References

1. Abbasi S A, Water quality sampling and analysis, Discovery Publishing New Delhi
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	<b>Name of the course : ES M21 E 27</b> <b>Climate Change and Governance</b>

<b>School Name</b>	School of Environmental Sciences						
<b>Programme</b>	<b>M.Sc. Environment Science and Management</b> <b>M.Sc. Environment Science and Disaster Management</b>						
<b>Course Name</b>	Climate Change & Governance						
<b>Type of Course</b>	Elective						
<b>Course Code</b>	ES M21 E 27						
<b>Names of Academic Staff &amp; Qualifications</b>	<b>Dr. E.V. Ramasamy, M.Tech., Ph.D</b> <b>Dr.C.T. Aravindakumar , PhD</b>						
<b>Course summary &amp; Justification</b>	<b>Course Summary:</b> This course is designed to provide a comprehensive idea on climate change including the drivers, impacts, mitigation and governance strategies. <b>Justification:</b> An in depth knowledge on Climate Change and the governance strategies is essential for the students of both Environment and Disaster Management students.						
<b>Semester</b>		<b>3</b>	<b>Credit</b>			<b>2</b>	
<b>Total Student Learning Time (SLT)</b>	<b>Learning approach</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Others</b>	<b>Total hrs</b>	
						<b>36</b>	
<b>Pre-requisite</b>							

<b>CO No.</b>	<b>At the end of the course, the student will be able to:</b>	<b>Taxonomic Level (TL)</b>	<b>PSO</b>
<b>1.</b>	Describe the basics of Climate Change and explains the changes occurred so far and prediction of the future changes	U, R,	1,2
<b>2</b>	Explain the causes of climate change and analyses the	U,R,A	2,4




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	impacts of climate change		
<b>3.</b>	Explain various procedures of inventorying the greenhouse gas emissions (GHG).	U,A,E	3,4
<b>4</b>	Evaluate long term mitigation pathways.	A	3,4
<b>5</b>	Explain various climate change adaptation methods, integrated natural resource management systems; evaluate various information systems including early warning systems.	U,A,R	4
<b>6</b>	Explain the global action and governance for climate change mitigation	U, R,C	9
<b>7</b>	Describe various technical and financial aids for climate change mitigation and adaptation	U	9

<b>Unit</b>	<b>Course Description</b>	<b>Hours</b>	<b>CO No.</b>
<b>1</b>	<b>Basic definitions</b>		
1.1	Climate and weather; climate change; greenhouse gases; radiative forcing; warming potential	<b>2</b>	<b>1</b>
1.2	climate modelling; global and regional circulation models; IPCC modelling scenarios.	2	<b>1</b>
<b>2</b>	<b>Observed and projected changes in the climate system</b>		
2.1	Land surface temperature; ocean surface temperature; precipitation; cryosphere ;sea level	<b>2</b>	<b>1,2</b>
2.2	Greenhouse gas (GHG) concentrations (CO <sub>2</sub> and Non CO <sub>2</sub> gases);	2	<b>1,2</b>


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	and extreme climatic events.		
<b>3</b>	<b>Drivers of climate change</b>		
3.1	Natural and anthropogenic radioactive forcing; solar irradiance; aerosols, water vapour and clouds; volcanic eruption	<b>2</b>	<b>2</b>
3.2	GHG emissions from energy, industries, and transport; and gross and net emissions from agriculture, forestry and other land use.	2	<b>2</b>
<b>4</b>	<b>Impacts of climate change</b>		
4.1	Physical systems (Glaciers, snow, ice and/or permafrost; Rivers, lakes, floods and/or drought; Coastal erosion and/or sea level effects)	<b>2</b>	<b>2</b>
4.2	Biological systems (Terrestrial ecosystems; aquatic ecosystems); Human and managed systems (Food production; Livelihoods, health and/or economics)	2	<b>2</b>
<b>5</b>	<b>Greenhouse gas inventorying</b>		
5.1	IPCC guidelines on national greenhouse gas inventorying; general guidance and reporting; guidance specific to energy	<b>2</b>	<b>2,3</b>
5.2	Industrial processes and product use (IPPU), agriculture, forestry and other land use (AFOLU), and waste; activity data	<b>2</b>	<b>2,3</b>
5.3	Emission factors; key categories; tiered approach; stock-difference and gain-loss methods; principles of reporting; measurement, reporting and verification (MRV) system.	2	<b>2,3</b>
<b>6</b>	<b>Climate change mitigation</b>		
6.1	Decarbonizing energy production; use of clean energy and enhancing the energy efficiency in industries, transport, and buildings; carbon dioxide storage and capture	<b>3</b>	4

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6.2	Bio economy or low carbon economy; enhancing the carbon sequestration capacity of forests and land use; climate smart agriculture; REDD+, long term mitigation pathways.	3	4
<b>7</b>	<b>Climate change adaptation</b>		
7.1	Social, ecological asset and infrastructure development	1	3,4
7.2	Technological process optimization; integrated natural resources management; institutional, educational and behavioural change or reinforcement	2	3,4,5
7.3	financial services including risk transfer; information systems to support early warning and proactive planning.	1	3,5
<b>8.</b>	<b>Climate change institutions and governance</b>		
8.1	UNFCCC - Conference of Parties (COP); International Climate Agreement; Policy approaches for adaptation and mitigation, technology and finance;	2	6
8.2	National Communications; Biennial Update Report; Intended Nationally Determined Contributions	2	6,7
8.3	Funding streams – Green Climate Fund, Forest Carbon Partnership Facility, Global Environment Facility, Adaptation fund, Bilateral and multilateral funds, and official development assistance fund, voluntary and compliance markets; global think tanks in climate change.	4	7

Teaching and Learning Approach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning (Video), interactive Instruction: Active co-operative learning, Seminars, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative.
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<b>Assessment Types</b>	<b>Continuous Internal Assessment (CIA)</b> <ul style="list-style-type: none"> <li>• Assignments</li> <li>• Seminar Presentation on selected topics</li> <li>• Quiz</li> <li>• Class tests</li> </ul> <b>Semester End examination</b>
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## References

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