Syllabus of 4 + 1 Year Integrated UG and PG Programme

w. e. f 2024-25 Academic Year

GRADUATE SCHOOL

Mahatma Gandhi University

P. D. Hills P O

Kottayam, Kerala

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Schools offering Majors

SL.No	School/Centre
1	School of Bio Sciences
2	School of Chemical Sciences
3	School of Computer Sciences
4	School of Environmental Sciences
5	School of Gandhian Thought and Development Studies
6	School of International Relations and Politics
7	School of Pure and Applied Physics
8	School of Social Sciences

Sl. No.	Major	Intake
SCIENCE		
1	Bio Sciences	6**
2	Chemistry	6
3	Computer Science	6
4	Environmental Science	6
5	Physics	6
SOCIAL SCIENCES		
1	Development Studies	5
2	Gandhian Studies	5
3	History	10
4	International Relations and Politics	10

Majors offered and Intake *1 seat shall be sanctioned over and above the intake in each major in the 3rd semester for students who opt for a change of major after two semesters.

**Progression to PG Shall be based on the specialization selected by students as Biochemistry (2 seats) Biotechnology (2 seats) and Microbiology (2 seats) based on merit.

Schools offering Minors/MDCs/AECs/VACs/SECs

SL.No	School/Centre
1	School of Artificial Intelligence And Robotics
2	School of Behavioural Sciences
3	School of Biosciences
4	School of Chemical Sciences
5	School of Computer Sciences
6	School of Data Analytics
7	School of Energy Materials
8	School of Environmental Sciences
9	School of Food Science And Technology
10	School of Gandhian Thought And Development Studies
11	School of Gender Studies
12	School of Indian Legal Thought
13	School of International Relations And Politics
14	School of Letters
15	School of Mathematics And Statistics
16	School of Nanoscience And Nano Technology
17	School of Pedagogical Sciences
18	School of Polymer Science And Technology
19	School of Pure And Applied Physics
20	School of Social Sciences
21	School of Tourism Studies
22	International and Inter University Centre for Nanoscience and Nanotechnology
23	K N Raj School of Economics

Scheme for 4 + 1 Integrated UG and PG Programme
Graduate School
Mahatma Gandhi University
School of Environmental Sciences

Course Code	Title	Credits	Hours per Week	Level	Type	
			Theory	Practical		
SEMESTER I						
MG1DSCUEN101	Introduction to Environmental Sciences	4	4		Foundation (100-199)	Major
MG1DSCUES121	Fundamentals of Environmental Science	4	4			Minor A
MG1DSCUES141	Natural disasters	4	4			Minor B
MG1MDCUES101	Environment and Development	3	3			MDC
	AEC (Eng)	3			"	
	AEC (Mal)	3			"	
SEMESTER II						
MG2DSCUEN101	Earth System Sciences	4	3	2	"	Major
MG2DSCUES121	Introduction to Ecosystems	4	4		"	Minor A
MG2DSCUES141	Concepts of Disaster Management	4	4		"	Minor B
MG2MDCUES101	Sanitation, Health and Environment	3	3			MDC

	AEC (Eng)	3			"	
	AEC (Mal)	3			"	
SEMESTER III						
MG3DSCUEN201	Ecology and Environment	4	3	2	Intermediate (200-299)	Major
MG3DSCUEN202	Environmental Chemistry	4	3	2	"	Major
MG3DSCUEN203	Environmental Pollution and Control	4	4		"	Major
MG3DSCUES221	Environmental Pollution	4	3	2	"	Minor A
MG3MDCUES201	Sustainable Development	3	3		"	MDC
MG3MDCUES202	Fundamentals of Disaster Management	3	3			MDC
MG3MDCUES203	Climate Change	3	3			MDC
MG3VACUES201	Carbon footprint analysis	3	3		"	VAC
SEMESTER IV						
MG4DSCUEN201	Environmental Monitoring and Assessment	4	3	2	"	Major
MG4DSCUEN202	Biodiversity & Conservation biology	4	4		"	Major
MG4DSCUEN203	Natural and Anthropogeni	4	4		"	Major

	c disasters					
MG4DSCUES241	Waste Management	4	4		"	Minor B
MG4SECUES201	Biodiversity Assessment	3	2	2	"	SEC
MG4VACUES201	Environmental Analysis	3	1	4	"	VAC
MG4INTUEN200	Internship/ Fieldwork	2				
SEMESTER V						
MG5DSCUEN301	Environment Management	4	4		Higher (300-399)	Major
MG5DSCUEN302	Analytical techniques and instrumentation	4	3	2	"	Major
MG5DSCUEN303	Environmental Biotechnology	4	4		"	Major
MG5DSCUEN304	Remote Sensing and GIS	4	3	2	"	Major
MG5SECUES301	Surveying and Mapping Techniques	3	1	4	"	SEC
MG5VACUES301	Elemental and Metal analysis	3	1	4	"	VAC
SEMESTER VI						
MG6DSCUEN301	Environmental Law, Policies, and Education	4	4		"	Major

MG6DSCUEN302	Environment Impact Assessment	4	4		"	Major
MG6DSCUEN303	Ecotoxicology	4	4		"	Major
MG6DSEUEN304	Energy Resources and Management	4	4		"	Major(E) (any 2)
MG6DSEUEN305	Solid waste management	4	4		"	
MG6DSEUEN306	Wildlife Protection and Management	4	4			
MG6SECUES301	Environment Management Plan	3	1	4	"	SEC
Total Credits	**133**					

SEMESTER VII						
MG7DSCUEN401	Research Methodology and Statistics	4	4		Advanced (400-499)	Major
MG7DSCUEN402	Wetland Management	4	4		"	Major
MG7DSEUEN403	Geoinformatics and environmental data analytics	4	3	2	"	Major(E) (any one)
MG7DSEUEN404	Environmental Microbiology	4	3	2		
MG7DSEUEN405	Disaster Risk Reduction for Sustainable	4	4			

	Development					
MG7DSCUES421	Remote sensing and GIS	4			"	Minor A
MG7DSEUES422	Climate change and Governance	4				Minor A (E)
MG7DSEUES441	Disaster Risk Management	4				MinorA/B (E)
SEMESTER VIII						
MG8DSCUEN401	Climate Change: Mitigation, Adaptation and Resilience	4	4		"	Major
MG8DSEUEN402	Environmental Economics for Sustainable Development	4	4		"	Major (E) (any one)
MG8DSEUEN403	Environmental Health and Safety	4	4			
MG8DSEUEN404	Standards in Humanitarian Aid, Relief and Rehabilitation	4	4			
MG8DSCUEN405	*Ecohydrology	4	4		"	Major*
MG8DSCUEN406	*Water Management	4	4		"	Major*
MG8DSCUEN407	*Hazardous Waste Management	4	4		"	Major*
MG8RPHUEN400	Research Project	12			"	

Total Credits		**44**				
SEMESTER IX						
ENVIRONMENT SCIENCE & MANAGEMENT (Specialization)						
MG9DSCUEN501	Environmental Engineering	4	4		PG Level (500-599)	Major
MG9DSCUEN502	Ecosystem Restoration	4	4		"	Major
MG9DSCUEN503	Advanced Geoinformatics	4	2	4	"	Major
MG9DSEUEN504	Ecoinformatics	4	3	2	"	Major (E)
MG9DSEUEN505	Advanced instrumentation techniques	4	2	4	"	Major (E)
ENVIRONMENT SCIENCE & DISASTER MANAGEMENT (Specialization)						
MG9DSCUEN511	Disaster Risk Assessment & Mitigation	4	4		PG Level (500-599)	Major
MG9DSCUEN512	Standards in Humanitarian Aid, Relief and Rehabilitation	4	4		"	Major
MG9DSCUEN513	Social Work Approaches and Practices	4	4		"	Major
MG9DSEUEN514	Governance, Law and Policies in Disaster Management	4	4		"	Major (E) (Any two)
MG9DSEUEN515	Public health aspects and emergency services in	4	4			

	disaster management					
MG9DSEUEN516	Advanced Geoinformatics	4	2	4		
MG9DSEUEN517	Advanced instrumentation techniques	4	2	4	"	
SEMESTER X						
MG10RPHUEN500	Research Project	20			"	
		4	4		"	Major**
		4	4		"	Major**
		4	4		"	Major**
		4	4		"	Major**
		4	4		"	Major**
Total Credits			**40**			

*Only for 4-Years Honours Students
**Only for students who opt for theory courses instead of Research Project

Note: General foundations courses shall be offered by different schools. Students can flexibly choose the courses across disciplines.

Level	Foundation (100-199	Intermediate (200-299)	Higher (300-399)	Advanced (400-499)	PG Level (500-599)

Type	Major	Minor	MDC	SEC	VAC	AEC

Scheme for 4 + 1 Integrated UG and PG Programme
Graduate School
Mahatma Gandhi University
School of Environmental Sciences

Course Code	Title	Credits	Hours per Week		Level	Type
			Theory	Practical		
SEMESTER I						
MG1DSCUEN101	Introduction to Environmental Sciences	4	4		Foundation (100-199)	Major
MG1DSCUES121	Fundamentals of Environmental Science	4	4			Minor A
MG1DSCUES141	Natural disasters	4	4			Minor B
MG1MDCUES101	Environment and Development	3	3			MDC
	AEC (Eng)	3			"	
	AEC (Mal)	3			"	
SEMESTER II						
MG2DSCUEN101	Earth System Sciences	4	3	2	"	Major
MG2DSCUES121	Introduction to Ecosystems	4	4		"	Minor A
MG2DSCUES141	Concepts of Disaster Management	4	4		"	Minor B
MG2MDCUES101	Sanitation, Health and Environment	3	3			MDC
	AEC (Eng)	3			"	
	AEC (Mal)	3			"	
SEMESTER III						
MG3DSCUEN201	Ecology and Environment	4	3	2	Intermediate (200-299)	Major
MG3DSCUEN202	Environmental Chemistry	4	3	2	"	Major
MG3DSCUEN203	Environmental Pollution and Control	4	4		"	Major
MG3DSCUES221	Environmental Pollution	4	3	2	"	Minor A
MG3MDCUES201	Sustainable Development	3	3		"	MDC
MG3MDCUES202	Fundamentals of Disaster Management	3	3			MDC
MG3MDCUES203	Climate Change	3	3			MDC
MG3VACUES201	Carbon footprint analysis	3	3		"	VAC
SEMESTER IV						
MG4DSCUEN201	Environmental Monitoring and Assessment	4	3	2	"	Major
MG4DSCUEN202	Biodiversity & Conservation biology	4	4		"	Major

MG4DSCUEN203	Natural and Anthropogenic disasters	4	4		"	Major
MG4DSCUES241	Waste Management	4	4		"	Minor B
MG4SECUES201	Biodiversity Assessment	3	2	2	"	SEC
MG4VACUES201	Environmental Analysis	3	1	4	"	VAC
MG4INTUEN200	Internship/Fieldwork	2				
SEMESTER V						
MG5DSCUEN301	Environment Management	4	4		Higher (300-399)	Major
MG5DSCUEN302	Analytical techniques and instrumentation	4	3	2	"	Major
MG5DSCUEN303	Environmental Biotechnology	4	4		"	Major
MG5DSCUEN304	Remote Sensing and GIS	4	3	2	"	Major
MG5SECUES301	Surveying and Mapping Techniques	3	1	4	"	SEC
MG5VACUES301	Elemental and Metal analysis	3	1	4	"	VAC
SEMESTER VI						
MG6DSCUEN301	Environmental Law, Policies, and Education	4	4		"	Major
MG6DSCUEN302	Environment Impact Assessment	4	4		"	Major
MG6DSCUEN303	Ecotoxicology	4	4		"	Major
MG6DSEUEN304	Energy Resources and Management	4	4		"	Major(E) (any 2)
MG6DSEUEN305	Solid waste management	4	4		"	
MG6DSEUEN306	Wildlife Protection and Management	4	4			
MG6SECUES301	Environment Management Plan	3	1	4	"	SEC
Total Credits		**133**				

SEMESTER VII						
MG7DSCUEN401	Research Methodology and Statistics	4	4		Advanced (400-499)	Major
MG7DSCUEN402	Wetland Management	4	4		"	Major
MG7DSEUEN403	Geoinformatics and environmental data analytics	4	3	2	"	Major(E) (any one)
MG7DSEUEN404	Environmental Microbiology	4	3	2		
MG7DSEUEN405	Disaster Risk Reduction for Sustainable Development	4	4			
MG7DSCUES421	Remote sensing and GIS	4			"	Minor A
MG7DSEUES422	Climate change and Governance	4				Minor A (E)
MG7DSEUES441	Disaster Risk Management	4				MinorA/ B (E)

SEMESTER VIII						
MG8DSCUEN401	Climate Change: Mitigation, Adaptation and Resilience	4	4		"	Major
MG8DSEUEN402	Environmental Economics for Sustainable Development	4	4		"	Major (E) (any one)
MG8DSEUEN403	Environmental Health and Safety	4	4			
MG8DSEUEN404	Standards in Humanitarian Aid, Relief and Rehabilitation	4	4			
MG8DSCUEN405	*Ecohydrology	4	4		"	Major*
MG8DSCUEN406	*Water Management	4	4		"	Major*
MG8DSCUEN407	*Hazardous Waste Management	4	4		"	Major*
MG8RPHUEN400	Research Project	12			"	
Total Credits		**44**				
SEMESTER IX						
ENVIRONMENT SCIENCE & MANAGEMENT (Specialization)						
MG9DSCUEN501	Environmental Engineering	4	4		PG Level (500-599)	Major
MG9DSCUEN502	Ecosystem Restoration	4	4		"	Major
MG9DSCUEN503	Advanced Geoinformatics	4	2	4	"	Major
MG9DSEUEN504	Ecoinformatics	4	3	2	"	Major (E)
MG9DSEUEN505	Advanced instrumentation techniques	4	2	4	"	Major (E)
ENVIRONMENT SCIENCE & DISASTER MANAGEMENT (Specialization)						
MG9DSCUEN511	Disaster Risk Assessment & Mitigation	4	4		PG Level (500-599)	Major
MG9DSCUEN512	Standards in Humanitarian Aid, Relief and Rehabilitation	4	4		"	Major
MG9DSCUEN513	Social Work Approaches and Practices	4	4		"	Major
MG9DSEUEN514	Governance, Law and Policies in Disaster Management	4	4		"	Major (E) (Any two)
MG9DSEUEN515	Public health aspects and emergency services in disaster management	4	4			
MG9DSEUEN516	Advanced Geoinformatics	4	2	4		
MG9DSEUEN517	Advanced instrumentation techniques	4	2	4	"	
SEMESTER X						
MG10RPHUEN500	Research Project	20			"	
		4	4		"	Major**
		4	4		"	Major**
		4	4		"	Major**
		4	4		"	Major**
		4	4		"	Major**
Total Credits		**40**				

*Only for 4-Years Honours Students
**Only for students who opt for theory courses instead of Research Project

Note: General foundations courses shall be offered by different schools. Students can flexibly choose the courses across disciplines.

Level	Foundation (100-199)	Intermediate (200-299)	Higher (300-399)	Advanced (400-499)	PG Level (500-599)

Type	Major	Minor	MDC	SEC	VAC	AEC

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List of Minor, MDC, VAC and SEC offered by School of Environmental Sciences

Semester	***Course***	***Type***
Semester - 1	Fundamentals of Environmental Science	Minor
	Natural disasters	Minor
	Environment and Development	MDC
Semester - 2	Introduction to Ecosystems	Minor
	Concepts of Disaster Management	Minor
	Sanitation, Health and Environment	MDC
Semester - 3	Environmental Pollution	Minor
	Sustainable Development	MDC
	Fundamentals of Disaster Management	MDC
	Climate Change	MDC
	Carbon footprint analysis	VAC
Semester -4	Waste Management	Minor
	Biodiversity Assessment	SEC
	Environmental Analysis	VAC
Semester -5	Surveying and Mapping Techniques	SEC
	Elemental and Metal analysis	VAC
Semester - 6	Environment Management Plan	SEC
Semester -7	Remote sensing and GIS	Minor
	Climate change and Governance	Minor
	Disaster Risk Management	Minor

Syllabus of Major Courses

Programme Specific Outcome (PSO)

PSO 1	To understand the basic concepts of environment, interactions with the earth and various ecosystems associated with it
PSO 2	Capable of analysing, evaluating, and interpreting the causes and effects of various environmental problems at local, regional, and global scales to develop management strategies.
PSO 3	Developing specific analytical skills in determining the magnitude of different kinds of environmental pollution and their sources using analytical and computational techniques.
PSO 4	Gaining a thorough knowledge of research methodology in general; specific ideas on understanding a research problem, identifying the research gaps, developing suitable research techniques/ methods including research design, data collection, data analysis with suitable statistical tools, interpretation of the findings leading to the perfect solution to the research problem undertaken.
PSO 5	Capacity to develop and apply treatment technology for water, wastewater, air, soil and solid waste and the ability to use different tools and techniques for environment management and develop skills in environment and disaster management
PSO 6	Mastering the core concepts and methods of economic, political, and social analysis, which are essential in designing and evaluating of environmental policies; conducting environmental/green auditing
PSO 7	Gaining a deep knowledge of ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems. Thus to evolve as an entrepreneur, a consultant with leadership skills necessary for the conservation of the environment

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme **ENVIRONMENTAL SCIENCE**

School	**Graduate School**		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Title	**Introduction to Environmental Science**		
Course Type	**Major**		
Course Level	100-199		
Course Code	**MG1DSCUEN101**		
Course Overview	The course introduces environmental science, exploring its definition, scope, and multidisciplinary nature. It covers the history of environmental protection, significant global issues, and key environmental movements. Additionally, it delves into environmental ethics, highlighting the importance of resource consumption and conservation.		
Semester	1	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/fieldwork**	
	60	15	
Pre-requisite	A foundational understanding of basic science concepts and familiarity with current environmental issues		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO
	Upon completion of this course, students will be able to;		
1	Dilate upon the scope and importance of Environmental Science and its multidisciplinary nature.	U	1
2	Comment on the history and origin of environmental protection initiatives and key international conferences.	R	1
3	Identify and classify major types of natural resources	U	1

4	Analyze the developmental issues and their environmental impacts.	An	2
5	Apply principles of environmental ethics to address the issues of equity and disparity.	A	1

COURSE CONTENT

		CO NO.
Module 1: Introduction to Environmental Science & Conservation History	15 Hours	1, 2
Definition, scope, and importance of Environmental Science, Multidisciplinary nature of environmental science; Significance of Environmental Education; Components of Environment. Origin of conservation NGOs like WWF, UNEP, etc., Silent Spring, Our Common Future. International initiatives for environmental protection – Ramsar convention, Stockholm conference, Rio Conferences, Conferences for reducing greenhouse gases and Ozone depleting substances, COPs; Major Environmental movements		
Module 2: Natural Resources	15 Hours	1,3
Introduction to natural resources; Types of natural resources- Renewable and Non-renewable resources; Types of natural resources- Forest resources, Water and soil resources, Mineral Resources, Energy Resources		
Module 3: Global Environmental Issues	15 Hours	3,4,5
Developmental issues and related impacts such as ecological degradation; environmental pollution; development-induced displacement, resettlement, and rehabilitation: problems, concerns, and compensative mechanisms; discussion on Project Affected People (PAPs). Production and consumption-oriented approaches to environmental issues in Indian and global context; impact of industry and technology on the environment; urban sprawl, traffic congestion, and social-economic problems; conflict between economic and environmental interests. Historical case studies of environmental crisis Climate Change, Global Warming, Acid Rain, Ozone Depletion, Nuclear Incidents, and Environmental Catastrophes – Case Analyses; Case Studies: Consumerism and Waste Management Practices.		
Module 4: Environmental Ethics	15 Hours	4,5

Aldo Leopold's Land Ethics and Gross National Happiness, Resource consumption patterns and the need for their equitable utilisation; Equity – Disparity in the Northern and Southern countries; Urban-rural equity issues; The need for Gender Equity; Preserving resources for future generations; The rights of animals; The ethical basis of environment education and awareness; The conservation ethic and traditional value systems of India; Anthropocentrism and Ecocentrism	

Mode of Transaction	**Classroom activities** **Field activities** **Lab based activities**
Mode of Assessment	**Assignment/Quiz/Discussion/Seminar** **Internal Exam (40%)** **Final Exam (70%)**

Learning Resources

1. Basu, M., & Xavier Savarimuthu, S. J. (2017). Fundamentals of environmental studies. Cambridge University Press.
2. Chawla, S. (2013). A Textbook of Environmental Studies. McGraw Hill Education (India) Private Limited.
3. Chokkan, K.B., Pandya, H. & Raghunathan, H. (eds). 2004. Understanding Environment. Sagar Publication India Pvt. Ltd., New Delhi
4. Elliot, D. 2003. Energy, Society & Environment, Technology for a Sustainable Future. Routledge Press.
5. Guha, R. 1989. Ecological change and peasant resistance in the Himalaya. Unquiet Woods, Oxford University Press, Delhi.
6. Miller, T.G. 2012. Environmental Science. Wadsworth Publishing Co
7. National Research Council (NRC). 1996. Linking Science and Technology to Society's Environmental Goals. National Academy Press.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme **ENVIRONMENTAL SCIENCE**

School	**Graduate School**		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Title	**Earth System Sciences**		
Course Type	**Major**		
Course Level	**100-199**		
Course Code	**MG2DSCUEN101**		
Course Overview	This course covers the Earth's formation, structure, and processes, including the formation of the solar system, geological time scale, plate tectonics, earthquakes, volcanoes, atmospheric circulation, and surface processes. It also examines mineral and rock formation and the impact of human activities on landscapes.		
Semester	**2**	**Credit**	**4**
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work// fieldwork**	
	60	15	
Pre-requisite	Basic knowledge about Earth		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Explain the formation of the Solar System, Earth's structure, and the origin of life.	R	1

2	Describe the geological processes occurring on Earth.	U	1
3	Understand the dynamics of Earth's atmosphere	U	1
4	Analyze different types and properties of rocks and minerals	An	1
5	Interpret surface and groundwater hydrology	U	1

COURSE CONTENT

		CO No.
Module 1: History of the Earth	15 Hours	1
Formation of Solar system and planetary differentiation; formation of the Earth: formation and composition of core, mantle, crust, atmosphere, and hydrosphere; chemical composition of the earth; geological time scale and major changes on the Earth with time.		
Module 2: Endogenic Processes and Exogenic Processes	15 Hours	2, 3
Movement of lithospheric plates; mantle convection and plate tectonics, major plates and hot spots, plate boundaries; continental drift and seafloor spreading. Introduction to Atmosphere and atmospheric processes- Atmospheric Structure, Clouds, Thermodynamics, Atmospheric circulations. Land surface processes: Aeolian, fluvial, and glacial processes, Weathering, erosional, and depositional landscapes; coastal processes. Groundwater hydrology.		
Module 3: Minerals and rocks	15 Hours	4
Minerals; atomic structure, physical properties, major rock-forming minerals; Rocks- classification, form, texture, and mineralogy of common Igneous, Metamorphic, Sedimentary, Rock cycle; Rock deformation: folds, faults and joints		
Module 4: Hydrology	15 Hours	2, 5
Surface water hydrology: Hydrological cycle, Factors affecting hydrological cycle. Groundwater hydrology: Aquifers – types and properties; Groundwater recharge; Methods of groundwater abstraction- undesirable side effects of over-exploitation. Sustainable groundwater development and management.		

Mode of Transaction	**Classroom activities** **Field activities** 1. Local Geological Fieldwork 2. Identifying common minerals and rocks in the field 3. Identification of common rock structures in the field **Lab based activities**

	1. Identification of Minerals and Rocks
Mode of Assessment	Continuous Evaluation **Assignment/Quiz/Discussion/Seminar** **Internal Exam (40%)** **Final exam (70%)**

Learning Resources

1. Bridge, J., &Demicco, R. 2008. Earth Surface Processes, Landforms & Sediment deposits. Cambridge University Press.
2. Duff, P. M. D., & Duff, D. (Eds.). 1993. Holmes' Principles of Physical Geology. Taylor & Francis.
3. Gupta, A. K., Anderson, D. M., &Overpeck, J. T. 2003. Abrupt changes in the Asian southwest monsoon during
   the Holocene and their links to the North Atlantic Ocean. Nature 421: 354-357.
4. Keller, E.A. 2011. Introduction to Environmental Geology (5th edition). Pearson Prentice Hall.
5. Leeder, M., Arlucea, M.P. 2005. Physical Processes in Earth & Environmental Sciences. Blackwell Publishing.
6. Pelletier, J. D. 2008. Quantitative Modeling of Earth Surface Processes (Vol. 304). Cambridge: Cambridge University Press. Chicago.
7. Grotzinger et al 2007 Understanding Earth, WH Freeman New York, 579 p

Syllabus of Minor Courses

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme **Environmental Science**

School	**Graduate School**		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Title	**Fundamentals of Environmental Science**		
Course Type	**Minor**		
Course Level	100-199		
Course Code	**MG1DSCUES121**		
Course Overview	The course introduces environmental science, exploring its definition, scope, and multidisciplinary nature. It covers the history of environmental protection, significant global issues, and key environmental movements. Additionally, it delves into environmental ethics, highlighting the importance of resource consumption and conservation.		
Semester	1	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work// fieldwork**	
	60	15	
Pre-requisite	A foundational understanding of basic science concepts and familiarity with current environmental issues		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Dilate upon the scope and importance of Environmental Science and its multidisciplinary nature.	U	1
2	Comment on the history and origin of environmental protection initiatives and key international conferences.	R	1

3	Identify and classify major types of natural resources	U	1
4	Analyze the developmental issues and their environmental impacts.	An	2
5	Apply principles of environmental ethics to address the issues of equity and disparity.	A	1

COURSE CONTENT

		CO NO.
Module 1: Introduction to Environmental Science & Conservation History	15 Hours	1, 2
Definition, scope, and importance of Environmental Science, Multidisciplinary nature of environmental science; Significance of Environmental Education. Origin of conservation NGOs like WWF, UNEP, etc., Silent Spring, Our Common Future. International initiatives for environmental protection; Major Environmental movements		
Module 2: Natural Resources	15 Hours	3
Introduction to natural resources; Types of natural resources- Renewable and Non-renewable resources; Types of natural resources- Forest resources, Water and soil resources, Mineral Resources, Energy Resources		
Module 3: Global Environmental Issues	15 Hours	4
Developmental issues and related impacts such as ecological degradation; environmental pollution; Project Affected People (PAPs). Environmental Challenges and Urbanization: Production and Consumption Perspectives, Industry and Technology Impacts, Economic-Environmental Conflicts Climate Change, Global Warming, Acid Rain, Ozone Depletion, Nuclear Incidents, and Environmental Catastrophes; Case Studies: Consumerism and Waste Management Practices.		
Module 4: Environmental Ethics	15 Hours	5
Aldo Leopold's Land Ethics and Gross National Happiness, Resource consumption patterns and the need for their equitable utilisation; Equity – Disparity in the Northern and Southern countries; Urban-rural equity issues; The need for Gender Equity; Preserving resources for future generations; The rights of animals; The ethical basis of environment education and awareness; The conservation ethic and traditional value systems of India; Anthropocentrism and Ecocentrism		

Mode of Transaction	**Classroom activities** **Field activities** **Lab based activities**

Mode of Assessment	**Assignment/Quiz/Discussion/Seminar** **Internal Exam (40%)** **Final exam (70%)**

Learning Resources

1. Basu, M., & Xavier Savarimuthu, S. J. (2017). Fundamentals of environmental studies. Cambridge University Press.
2. Chawla, S. (2013). A Textbook of Environmental Studies. McGraw Hill Education (India) Private Limited.
3. Chokkan, K.B., Pandya, H. & Raghunathan, H. (eds). 2004. Understanding Environment. Sagar Publication India Pvt. Ltd., New Delhi
4. Elliot, D. 2003. Energy, Society & Environment, Technology for a Sustainable Future. Routledge Press.
5. Guha, R. 1989. Ecological change and peasant resistance in the Himalaya. Unquiet Woods, Oxford University Press, Delhi.
6. Miller, T.G. 2012. Environmental Science. Wadsworth Publishing Co
7. National Research Council (NRC). 1996. Linking Science and Technology to Society's Environmental Goals. National Academy Press

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**Graduate School**		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Title	**Natural disasters**		
Course Type	**Minor**		
Course Level	**100-199**		
Course Code	**MG1DSCUES141**		
Course Overview	This course covers an overview of disasters of natural origin. Students will gain an in-depth understanding of various types of disasters, including their physical, social, economic, and environmental dimensions. Through case studies, theoretical frameworks, and practical applications, the course aims to equip students with the knowledge and skills to effectively analyse, mitigate, and respond to natural disaster events.		
Semester		**Credit**	**4**
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work// fieldwork**	
	60	15	
Pre-requisite	Basic knowledge about Geology		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Explain the characteristics of natural disasters and understand their respective characteristics and dynamics.	R	1

2	Describe the short-term and long-term impacts of disasters on communities, economies, and environments.	U	1,2
3	Understand emerging challenges of disasters in the contemporary world including climate change	U	2
4	Analyze the factors that contribute to the vulnerability of various natural disasters	An	1,2
5	Understand the historical and contemporary case studies of disasters to identify lessons learned and best practices	U	1

COURSE CONTENT

		CO NO.
Module 1: Introduction to Natural Hazards	10 Hours	1, 2
Science and facts of natural hazards, Causal factors and characteristics of natural disasters, major natural hazards across the world, natural hazard profile of India		
Module 2: Water and Climate Related Disasters	15 Hours	1, 2
Cause, effects, types and measurements of Floods, Cyclones, Tornadoes, Hail storm, Hot wave , Cold wave, Snow avalanches, Droughts, Acid rain, Sea erosion, Thunder and lightning		
Module 3: Geologically Related Disasters	15 Hours	1, 2
Geological factors for various disasters, Cause, effects, types and measurements of Landslides, Earthquakes, Mine fires, Groundwater contamination,Volcanic eruptions and Tsunamis		
Module 4: Significant Historical Natural Disasters	20 Hours	3, 4, 5
Introduction to historical disasters, global disaster databases - CRED and EMDAT, Case studies of notable international, national and regional disasters		

Mode of Transaction	**Classroom activities** 2. Practice safety procedures during natural disasters 3. In-depth analysis of specific natural disaster events 4. Plan and organize study trips local natural disaster affected cites
Mode of Assessment	Continuous Evaluation **Assignment/Quiz/Discussion/Seminar** **Internal Exam (40%)** **Final exam (70%)**

Learning Resources

1. Keller E.D., and Blodgett R. H, 2006. Natural Hazards. Pearson Printice Hall

2. Natural Hazards, Unnatural Disasters: The Economics of Effective Prevention" by the World Bank and United Nations
4. Kapur A., Neeti, Meena, Deepthima, Roshani and Debanjali, Disasters in India Studies. Rawat Publications, New Delhi
5. Peduzzi P., Dao H., and Herold C., 2005. Mapping Disastrous Natural Hazards Using Global Datasets Natural Hazards Volume 35, Number 2, 265-289.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**Graduate School**		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Title	**Introduction to Ecosystems**		
Course Type	**Minor**		
Course Level	**100-199**		
Course Code	**MG2DSCUES121**		
Course Overview	This course provides insight into the basics of ecosystems and their processes, including biogeochemical cycles, as well as an overview of various ecosystems of the world, their characteristics, and their significance. It also explains the various ecosystem services and their relevance to human and other well-being.		
Semester	1	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work// fieldwork**	
	45 hrs	15	
Pre-requisite	Basic understanding about science concepts, interest in ecological studies and affection to nature.		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		

1	Understand the basic concepts of ecosystems and their processes	U	1
2	Identify the key components of ecosystems and understand their roles	An, U	1
3	Analyse the threats of various ecosystems of world	An	1
4	Evaluate the various services offered by the ecosystems	E	1,2

COURSE CONTENT

		CO NO.
Module 1: Ecosystems	10 Hours	1, 2
Ecosystem : Concept , Biotic and Abiotic components; Ecosystem processes – Photosynthesis and decomposition; Food chain, Food web, Ecological pyramids, Trophic structure and levels. Flow of energy, Ecological efficiencies . Concepts of productivity and homeostasis. Biogeochemical cycles - Gaseous and Sedimentary cycles – Carbon, Nitrogen, Sulphur, Phosphorus cycles. Anthropogenic activities and its impacts of biogeochemical cycles.		
Module 2: Terrestrial ecosystems	12 Hours	1, 2
Terrestrial biomes of the world : Various types of tropical forest ecosystems : Characteristics, distribution, climate; stratification, floral-faunal interactions; Conservation aspects Desert ecosystem: Characteristics, vegetation, adaptations; Savanna woodlands: Temperate ecosystems : Boreal forests, tundra, Case studies : Overview of Forest types in India		
Module 3: Freshwater and Marine ecosystems	15 Hours	1, 2
Aquatic biomes of the world Freshwater ecosystems – Lentic water bodies : Pond, Lakes - Types based on origin; based on thermal stratification; Reservoirs. Lotic water bodies: streams, springs, Rivers – abiotic parameters and biotic communities. Marine ecosystems : Coastal zones, Mangroves, Coral reefs, Salt marshes, Intertidal zone, Rocky shore, Lagoons, Sea grass and Kelp forests, Large marine areas, Polar marine environment Wetlands: Freshwater and Marine Case studies : Over view of Aquatic ecosystems of India;		
Module 4: Ecosystem – Significance and Conservation	8 Hours	3, 4, 5
Ecosystem services (Provisioning, Regulating, Cultural, and Supporting); Ecosystem preservation and conservation strategies; Basics of Ecosystem restoration		

Mode of Transaction	**Classroom activities** Library reference and Video screening **Field activities :** Field visits to near by terrestrial and aquatic ecosystems **Lab based activities** : Assessment of primary productivity

Mode of Assessment	**Quiz, Seminar, Assignment** **Internal Exam (40%)** **Final exam (70%)**

Learning Resources

1. Odum, E. P. & Barrett, G. W. 2006. Fundamentals of Ecology (Cengage)
2. Smith R. L & Smith, T. M. Ecology and Field Biology. Benjamin Cummings/Addition Wesley
3. Dash, M. C. & S. P. Dash, Fundamental of Ecology. Tata Mcgraw Hill Publication.
4. Singh, J. S., Singh, S. P. & Gupta, S. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**Graduate School**		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Title	**Concepts of disaster management**		
Course Type	**Minor**		
Course Level	**100-199**		
Course Code	**MG2DSCUES141**		
Course Overview	This course introduces the basic principles and practices of disaster management. Students will explore the various phases of disaster management; mitigation, preparedness, response, and recovery- while gaining insights into hazard assessment, risk analysis, and community resilience. Students will learn to apply theoretical knowledge to real-world scenarios through case studies and practical applications.		
Semester		**Credit**	**4**
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work// fieldwork**	
	60	15	
Pre-requisite	Basic knowledge about Geography		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.

	Upon completion of this course, students will be able to;		
1	Explain fundamental concepts and principles of disaster management, including the different phases and their importance.	R	1
2	Understand the mechanisms for effective disaster response.	U	1,2
3	Understanding key principles and phases of disaster management	U	1
4	Perform vulnerability assessments and analyze potential impacts to determine risk levels.	An	1,2
5	Understand the role of international organizations in disaster management.	U	1

COURSE CONTENT

		CO NO.
Module 1: Introduction to Disaster Management	10 Hours	1, 2
Introduction to key concepts, terminologies and their complexities (Hazard, vulnerability, Exposure, Risk, Crisis, emergencies, Vulnerability, Disasters, Resilience)		
Module 2: Disaster Management Spectrum	15 Hours	2, 3
The disaster management cycle- Mitigation (structural and non structural), mitigation goals, Preparedness (planning, training and exercises,Public awareness and education), Response (emergency operations centers, search and rescue operations, incident command system , medical care and shelter management) , Recovery (damage assessment , reconstruction and rehabilitation)		
Module 3: Risk Assessment and Vulnerability Analysis	15 Hours	3, 4
Disasters and development, hazard identification, vulnerability analysis, exposure assessment, risk analysis, evaluation and mitigation, physical, socioeconomic, environmental and institutional vulnerability		
Module 4: Disaster Management Administration	20 Hours	3, 4, 5
International disaster management system, international disaster response laws, Disaster Management Act, NDMA, NIDM, NDRF, SDMA and DDMA. Role of various stakeholders in disaster management administration		

Mode of Transaction	**Classroom activities** Vulnerability assessment role-play Risk matrix analysis Disaster mock drill- tabletop exercises
Mode of Assessment	Continuous Evaluation **Assignment/Quiz/Discussion/Seminar** **Internal Exam (40%)** **Final exam (70%)**

Learning Resources

1. Shaw R and Krishnamurthy R.R., (ed.)2009. Disaster management Global Challenges and Local solutions. University Press, India.
2. Disaster Management: A Disaster Manager's Handbook" by Asian Development Bank
3. Principles of Emergency Management and Emergency Operations Centers (EOC)" by Michael J. Fagel
4. Coppola D. P., 2007.Introduction to International Disaster Management. Elsevier. Butterworth-Heinemann

Syllabus of MDC courses

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**Graduate School**		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Title	**Sanitation, Health and Environment**		
Course Type	**MDC**		
Course Level	**100-199**		
Course Code	**MG2MDCUES101**		
Course Overview	The course explores sanitation and health issues, waste management techniques, and ecological sanitation methods. It also analyzes the impacts of pollutants on organisms and food contamination, considering exposure routes and toxicity testing. Furthermore, it helps to understand the interplay between sanitation practices, human health, and environmental sustainability.		
Semester	2	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work// fieldwork**	
	45		

Pre-requisite	Interest in public health and environmental concepts, including sanitation, waste management, and pollutants.

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Understand the role of sanitation in Public health	U	1
2	Comprehend ecological sanitation principles and their impact on human health and food security.	U	1
3	Analyze the effects of pollutants on organisms and food contamination	An	1,2
4	Compare successful sanitation strategies and understand the health sector's role in sanitation improvement.	E	1

COURSE CONTENT

		CO NO.
Module 1: Sanitation and Health	10 Hours	1
Sanitation and Health- introduction and Current situation, Water and sanitation related diseases, respiratory infections, under-nutrition; Successful approaches to sanitation strategies; Role of the health sector; Global experience in improving sanitation and hygiene; Climate change and diseases; Occupational health		
Module 2: Waste Management	12 Hours	1, 2
Solid and liquid waste: Types, sources, properties, and impacts; Treatment/ processing techniques for solid wastes: Thermal and Biological processes; Disposal techniques: Landfills – design, operation, and management; Hazardous waste management; Wastewater treatment: an overview; Concept of Zero waste		
Module 3: Ecological Sanitation	11 Hours	1, 2,
Conventional sanitation: a linear flow system – its limitations; Eco San –Circular flow and closing the loop: concept, goals, and advantages; Eco San for human night soil management: Dry Toilets, Composting Toilets. Grey water management; Eco San - Human Health and Food Security		
Module 4: Pollutants and individual organisms	12 Hours	2, 3, 4
Routes and types of exposure to toxic substances; Toxicity of pollutants such as metals, pesticides, radioactive minerals, etc.; Effects of pollutants on individual organisms. Contaminants in food; Occupational exposure to toxins; Toxicity from substances used in daily life: cosmetics, cleansing agents etc. Toxicity testing		

Mode of Transaction	**Classroom activities** **Field activities** **Lab based activities**
Mode of Assessment	**Assignment/Quiz/Discussion/Seminar** **Internal Exam (40%)** **Final exam (70%)**

Learning Resources

1. Walker, CH., Hopkin, S.P., Sibly RM., Peakall DB. Principles of Ecotoxicology, Taylor and Francis, New York
2. Lippmann, M. (Ed.). (2000). Environmental toxicants: human exposures and their health effects.
3. Prabhakar VK. Toxic and Hazardous chemicals, Anmol, New Delhi
4. Sarkar, B. (2002). *Heavy metals in the environment*. CRC press.
5. Letcher, T., & Vallero, D. A. (Eds.). (2019). *Waste: A handbook for management*. Academic Press.
6. Singh, J., & Ramanathan, A. L. (Eds.). (2010). *Solid waste management: present and future challenges*. IK International Pvt Ltd.
7. Sinha, B. D., & Menon, P. S. K. (2000). *Environmental sanitation health and panchayati raj*. Concept Publishing Company.
8. Rajaram, V., Siddiqui, F. Z., Agrawal, S., & Khan, M. E. (2016). *Solid and liquid waste management waste to wealth: Solid and liquid waste management waste to wealth*. PHI Learning Pvt. Ltd..

SEMESTER III

	MAHATMAGANDHIUNIVERSITY **Graduate School**
	4+1Integrated UG and PG Programme **ENVIRONMENTAL SCIENCE**

School	**Graduate School**		
Programme	**4+ 1 Integrated UG and PG Programme**		
Course Title	**Ecology and Environment**		
Course Type	**Major**		
Course Level	**200-299**		
Course Code	**MG3DSCUEN201**		
Course Overview	The course provides an introduction into the basics of Ecology and Environmental Science. The concepts of the different spheres and processes of Environment, ecosystem, population ecology and the interaction of different ecological factors with biotic components are laid out.		
Semester	**3**	**Credit**	**4**
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/labwork//fieldwork**	
	60	15	
Pre-requisite	Basic knowledge about Ecological functions		

COURSEOUTCOMES(CO)

CO No.	**Expected Course Outcome** *Upon completion of this course, students will be able to;*	Taxonomic Level (TL)	**PSO No.**
1	Explain the concept of ecology and relevance of environmental science	U	1
2	Able to distinguish the structure, organization and processes in various ecosystems	A	1,2
3	Develop a knowledge of the structural and functional aspects of a population as an ecological unit	Ap	2,4
4	Understand and analyse the concept of biological community, changes and interactions within community	U, A	1,2,6
5	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	5,7

COURSE CONTENT

		CO NO
Module 1: Introduction to Ecological Factors	15 Hours	1,2
Scope and interdisciplinary nature of Environmental Science; Atmosphere- Structure and composition (concepts of homosphere and heterosphere and layers of atmosphere); hydrosphere- marine water, freshwater, concepts of halocline and thermocline in temperate lakes; lithosphere - biosphere. Environmental factors, concept of limiting factors. Biogeochemical cycles (gaseous and sedimentary).		
Module 2: Ecosystem functions and processes	15 Hours	2,3
Classification; Biogeographical regions; Biomes; Energy flow; Trophic relations; Ecological pyramids; Productivity and ecological efficiencies: primary and secondary producers. Niche; Speciation; Ecological Succession and Climax communities, ecotone, edge effect; Biological interactions - Positive and Negative interactions: Mutualism, Proto-cooperation, Commensalism, Competition, Amensalism, Parasitism, Predation.		
Module 3: Population Ecology	15 Hours	4
Definition, Structure and Measures. Population growth, Regulation strategies of species. Survivability Population genetics. Human population. Population disturbance, population dispersal (migration, immigration and emigration), Population structure- Isolation, distribution, population explosion-causes and control measures.		
Module 4: Community Ecology and Applied Ecology	15 Hours	4,5
Concepts, Community gradients, Characters of community, Ecological Succession and climax Community, Organization -interactions between species. Stress ecology and adaptation. Estimating abundance, species diversity measures. Taxonomy and Biosystematics. Biomass productivity and estimation techniques		

Mode of Transaction	**Classroom activities** **Field activities** **Lab based activities**

Mode of Assessment	Continuous Evaluation **Assignment/Quiz/Discussion/Seminar** **Internal Exam (40%)** **Final exam (60%)**

Learning Resources

1. Arora S. (2003). Fundamentals of Environmental Biology, Kalyani Publications, New Delhi.
2. Cotgreave P. and Forseth I. (2002). Introductory Ecology. Blackwell Science, UK
3. Dhaliwal G. S., Sangha G. S. and Raina P. K. (2000) Fundamentals of Environmental Science, Kalyani Publication, India.
4. Freedman B. (1995). Environmental Ecology, Academic Press, USA.
5. Jackson A. R. W. and Jackson J. M. (2000). Environmental Science – The natural environment and human impact, 2nd Edition, Longman Group, UNITed Kingdom.
6. Masters G. M. (2007). Introduction to Environmental Science and Engineering, 3rd Edition, Prentice –Hall of India Pvt Ltd, New Delhi.
7. Odum E.P. (1993). Fundamentals of Ecolgy, W.B.Saunders Co., USA.
8. Rana S.V.S. (2005). Essentials of Ecology and Environmental Science. Prentice –Hall of India Pvt. Ltd. New Delhi
9. Townsend C.R., Begon M. and Harper J.L. (2008). Essentials of Ecology, Blackwell Publications, UK.

	MAHATMAGANDHIUNIVERSITY **Graduate School**
	4+1Integrated UG and PG Programme **ENVIRONMENTAL SCIENCE**

School	**Graduate School**		
Programme	**4+ 1 Integrated UG and PG Programme**		
Course Title	**Environmental Chemistry**		
Course Type	**Major**		
Course Level	**200-299**		
Course Code	**MG3DSCUEN202**		
Course Overview	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.		
Semester	**3**	**Credit**	**4**
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work//fieldwork**	
	60	15	
Pre-requisite	Basic knowledge about chemical characteristics of Environmental processes		

COURSE OUTCOMES (CO)

CO No.	**Expected Course Outcome** *Upon completion of this course, students will be able to;*	Taxonomic Level (TL)	**PSO No.**
1	Describe the basics of environmental chemistry	UR	1
2	Demonstrate knowledge of chemical and biochemical principles of fundamental environmental processes in air, water, and soil.	U	1,2,3
3	Describe the chemistry of air, water and soil pollutants	E	3,5
4	Apply basic chemical concepts to analyse chemical processes involved in different environmental problems (air, water & soil)	Ap	4,5,6
5	Describe Chemical and physical factors involved in Fate and transport of pollutants	Ap	3,7

COURSE CONTENT

		CO NO
Module1: Man, and environment	15 Hours	**1**
Definition. Principles and scope of Environmental Science. Chemistry and the Environment. Man, and Environment. Water and the hydrosphere, Air and the atmosphere. Energy and cycles of energy, Chemical fate and transport.		
Module2: Chemistry of the environment - basics	15 Hours	1, 2
Mass and Energy transfer across the various interfaces, material balance. First and Second law of thermodynamics. Heat transfer processes, Chemical potential; Chemical equilibria, acid· base reaction. Solubility product, solubility of gases in water, the carbonate system. Unsaturated and saturated hydrocarbons.		
Module3: Atmospheric chemistry	15 Hours	3, 4
The atmosphere Composition of Air: Classification of elements, chemical speciation. Particles, ions and radicals in the atmosphere. Chemical and photochemical reactions in the atmosphere, reactions of atmospheric oxygen. Chemical processes for formation of inorganic and organic particulate matter. Chemistry of air pollutants, Photochemical smog. Energy transfer in atmosphere, Global climate and microclimate.		
Module4: Aquatic and soil chemistry	15 Hours	3, 4, 5
Fundamentals of aquatic chemistry, The importance of water, The properties of water, gases in water. Concept of DO, BOD, COD, sedimentation, coagulation, filtration, Redox potential. Soil Chemistry - Nature and decomposition of soil, Inorganic and organic components of soil, Acid base and ion exchange reactions in soils, macro and micronutrients in soil, Nitrogen pathways, NPK in soils		

Mode of Transaction	**Classroom activities** **Field activities** **Lab based activities**
Mode of Assessment	Continuous Evaluation **Assignment/Quiz/Discussion/Seminar** **Internal Exam (40%)** **Final exam (60%)**

Learning Resources

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

	MAHATMAGANDHIUNIVERSITY **Graduate School**
	4+1IntegratedUGandPGProgramme **ENVIRONMENTAL SCIENCE**

School	**Graduate School**		
Programme	**4+ 1 Integrated UG and PG Programme**		
Course Title	**Environmental Pollution and Control**		
Course Type	**Major**		
Course Level	**200-299**		
Course Code	**MG3DSCUEN203**		
Course Overview	The modules under this course have been designed to improve the familiarity of the students with different pollution problems and the control strategies in three environmental compartments, i.e. air, water and soil. Issues related to noise pollution and their impact on environment and health are dealt with.		
Semester	**3**	**Credit**	**4**
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/labwork//fieldwork**	
	60	15	
Pre-requisite	Basic knowledge about different types of Environmental Pollution		

COURSE OUTCOMES(CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Taxonomic Level (TL)	PSO No.
1	Identify and distinguish the sources and types of water, air, and soil pollution.	R	2, 3
2	Articulate knowledge about impact and control measures of water, air, and soil pollution.	U	3
3	Describe environmental analysis for various water, air and soil quality parameters.	E	3,4
4	Expound the water and waste water treatment	U	5
5	Explain the Fate and transport of pollutants and distinguish the regional and global impact of pollution	A	4, 5
7	Conduct environmental sampling and analysis for monitoring environmental pollution, and implement policies for pollution control	Ap	4, 6, 7

COURSE CONTENT

		CO NO
Module 1: Air Pollution	15 Hours	**1, 2**
Air Pollution – Definition and Sources - Natural and anthropogenic; Types of Pollutants- Primary and Secondary. Acid rain, Smog-Photochemical and Classical; Ozone depletion. Factors affecting air pollution, Transport and diffusion of pollutants. Gas laws governing the behaviour of pollutants in the atmosphere. Indoor air pollution – Types and sources of pollutants. Effects of pollutants on human beings, plants, animals, materials and on climate. Identification of aeroallergens. Air-borne diseases and allergies. Air pollution control. Noise Pollution and control: Characteristics of noise, sources, Effects of noise, Standards, Measurement and control		
Module 2: Water Pollution	20 Hours	1, 2, 4
Water Pollution - Types -surface and ground water, Surface water pollution-Sources – point and nonpoint, Types of pollutants – chemical, physical and biological. Chemical pollutants – inorganic (metals and other elements) and organic (POPs); Nutrients and Eutrophication, Organic matter - sources and degradation. Biological pollutants Microbial pollution. Coastal and Marine pollution-Oil spills, Thermal pollution, Impacts of water pollution. Management of point and non-point sources of water pollution, water pollution control, Role of State and Central Pollution Control Boards		
Module 3: Soil Pollution	10 Hours	1, 2
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.		
Module 4: Environmental Pollution Monitoring	15 Hours	3, 5
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. Water and soil quality parameters		
Module5: Radioactive Pollution	10 Hours	5, 7
Radioactivity in the environment, Radioactive Pollution: Radionuclides- sources, types of radiation, Radioactive fallout. Ecological risks from radiation, effects on humans, exposure standards. Control measures: radioactive waste treatment.		

Mode of Transaction	**Classroom activities** **Field activities** **Lab-based activities**
Mode of Assessment	Continuous Evaluation **Assignment/Quiz/Discussion/Seminar** **Internal Exam (40%)** **Final exam (60%)**

Learning Resources

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, 10th 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, 4th edition. Tata McGraw Hill, New Delhi

	MAHATMAGANDHIUNIVERSITY **Graduate School**
	4+1IntegratedUGandPGProgramme **ENVIRONMENTAL SCIENCE**

School Name	Graduate School		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Name	**Environmental Pollution**		
Type of Course	Minor		
Course Level	200 – 299		
Course Code	**MG3DSCUES221**		
Course Overview	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.		
Semester	**3**	**Credit**	**4**
Total Student Learning Time (SLT)	**Instructional hours for theory**		**Instructional hours for practical/lab work/ fieldwork**
	45		
Pre-requisite			

CO No.	***At the end of the course, the student will be able to:***	**Taxonomic Level (TL)**	**PSO**
1.	Identify and distinguish the sources and types of water, air, and soil pollution.	R	1,3
2	Articulate knowledge about impact and control measures of water, air, and soil pollution.	U	2,5
3	Explain the Fate and transport of pollutants and distinguish the regional and global impact of pollution	A	2,3,7
4	Describe Radioactive pollution and radioactive waste management methods	U	5
5	Conduct environmental sampling and analysis	Ap	3,5

COURSE CONTENT

		CO NO
Module 1: Air Pollution	**15 Hours**	1, 2
Air Pollution – Definition and Sources - Natural and anthropogenic; Types of Pollutants- Primary and Secondary; Acid rain, Smog-Photochemical and Classical; Ozone depletion Factors affecting air pollution, Transport, and diffusion of pollutants. Gas laws governing the behaviour of pollutants in the atmosphere. Indoor air pollution – Types and sources of pollutants Effects of pollutants on human beings, plants, animals, materials and climate. Identification of aeroallergens. Air-borne diseases and allergies. Air pollution control Noise Pollution and Control: Characteristics of noise, sources, Effects of noise, Standards, Measurement and Control		
Module 2: Water Pollution	**15 Hours**	1, 2
Water Pollution - Types -surface and groundwater, Surface water pollution -sources – point and nonpoint, Types of pollutants – chemical, physical and biological. Chemical pollutants – inorganic (metals and other elements) and organic (POPs); Nutrients and Eutrophication, Organic matter - sources and degradation. Biological pollutants - Microbial pollution Groundwater pollution – sources and types of pollutants, Geological and anthropogenic pollutants in groundwater – Arsenic, Fluoride, Saline water intrusion, etc. Movements of contaminants in groundwater Coastal and Marine pollution -Oil spills, Thermal pollution, Impacts of water pollution -Heavy metals and other POPs in aquatic systems - cycling and interactions, Fate and transport of pollutants- factors affecting, Global oceanic transport of pollutants Management of point and non-point sources of water pollution, water pollution control, Role of State and Central Pollution Control Boards		
Module 3: Soil Pollution	**8 Hours**	1, 2
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. Sedimentation rate and contamination profile, sediment pollution indices Soil Pollution Control. Industrial waste effluents and heavy metals and their interactions with soil components. Soil microorganisms and their functions,		

Degradation of different insecticides, fungicides and weedicides in soil. Different kinds of synthetic fertilizers (NP & K) and their interactions with components of soil.		
Environmental Pollution monitoring	**12 Hours**	3, 5
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, Water quality parameters-physical, chemical and biological, analysis, Water quality standards, Tracers – dyes and isotopes in pollution monitoring Ambient Air quality Monitoring, Air quality Standards-ambient and emission, Air Sampling equipment. Methods of monitoring and control of air pollution SO_2, NO, CO, CO_2, Ozone, SPMPM2.5 & PM 10. Air quality index. Noise measurement Soil/sediment sampling and monitoring. Soil quality standards. Methods for assessing pollutant contamination profile in the sediments – chronology and pollutant detection		
Radioactive Pollution	**6**	4
Radioactivity in the environment, Radioactive Pollution: Radionuclides- sources, types of radiation, Radioactive fallout, Ecological risks from radiation, effects on humans, exposure standards. Control measures: radioactive waste treatment.		
Emerging contaminants	**4**	3, 5
Emerging contaminants – definition, types and sources Sources and health impacts of PPCPs, POPS, PCCDS, PFAs, Dioxins, PCBs Plastics pollution in the freshwater and marine ecosystems Natural disasters and Pollution		

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

Learning Resources

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, 10th 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, 4th edition. Tata McGraw Hill, New Delhi.
9. Miller R.W. and Donalvee, R.L. (1997). Soils in Our Environment, 7th Ed, Prentice Hall of India Pvt. Ltd.
10. Nathanson, J.A. (2003). Basic Environmental Technology, 4th 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.
13. Rao, C.S. (1995). Environmental Pollution Control Engineering, 3rd Ed., Wiley Eastern Ltd. New Age International Pvt. Ltd.
14. Sharma, B.K. (2001). Water Pollution. Goel Pub. House. Meerut.
15. Wadhwa, Y. (2009). Air Pollution: Causes and Control. Cyber Tech Publications, New Delhi

Suggested readings

1. http://echo2.epfl.ch/VICAIRE/mod_2/chapt_9/main.htm
2. http://www.bis.org.in/
3. http://www.science.uwaterloo.ca/~cchieh/cact/applychem/watertreatment.html
4. http://www.sciencedirect.com/science/journal/02697491?sdc=1
5. http://www.water-pollution.org.uk/types.html
6. https://link.springer.com/journal/11270
7. https://www.journals.elsevier.com/atmospheric-pollution-research/
8. https://www.journals.elsevier.com/environmental-pollution/

	MAHATMAGANDHIUNIVERSITY **Graduate School**
	4+1IntegratedUGandPGProgramme **ENVIRONMENTAL SCIENCE**

School Name	Graduate School		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Name	**Sustainable Development**		
Type of Course	MDC		
Course Level	200 – 299		
Course Code	**MG3MDCUES201**		
Course Overview	This course explores the principles, challenges, and practices of sustainable development. Students will understand the interconnection between environmental, social, and economic systems and learn strategies for achieving local, national, and global sustainability goals.		
Semester	**3**	**Credit**	**3**
Total Student Learning Time (SLT)	**Instructional hours for theory**	**Instructional hours for practical/lab work/ fieldwork**	
	45		
Pre-requisite			

CO No.	*At the end of the course, the student will be able to:*	Taxonomic Level (TL)	PSO
1.	Explain the basics of concepts and theories of sustainable development	R, U	1,7
2	Distinguish various problems which threaten sustainability	A	2,6
3.	Identify methods, tools, and techniques for sustainability	R	5,6

4	Analyse the role of international organizations, governments, and communities in advancing sustainable development.	A	6,7
5	Apply sustainability frameworks like the UN Sustainable Development Goals (SDGs) in real-world scenarios.	Ap	4,6,7

COURSE CONTENT

		CO NO
Module 1: Sustainability and Sustainable Development	**10 Hours**	1, 2
From problems to crises- Depletion of resources and environmental degradation Sustainable Development: History, Strategies and Policies. Sustainable human development index, Sustainability pillars - Key principles and dimensions of economic, social and environmental sustainability; Gandhian model of sustainable development; UN Sustainable development goals and achievements; Global challenges in sustainable development		
Module 2: Sustainable Consumption	**10 Hours**	2
Definition, importance, relevance for developing countries - Difference between Sustainable Consumption from Sustainable Development and Sustainable Production - key issues - UN Guidelines - Sustainable consumption Tools; Sustainable living and values		
Module 3: Sustainable Development in Practice	**7 Hours**	2, 3
Case studies - Successful sustainability initiatives; Policy and Governance for Sustainability; Corporate social responsibility (CSR); Sustainable Urban Development		
Module 4: Measuring and Monitoring Sustainability	**8 Hours**	3, 4, 5
Sustainability frameworks and standards – UNSDG, GRI, SASB, ISSB, TCFD, CDP, CSRD, BRSR etc. Environmental Impact Assessment for Sustainable Development- EMP- CER.		
Module 5: Education for Environment and Sustainable Development	**10 Hours**	4, 5
Environmental education; Education for sustainable development; Education for sustainable consumption; eco–school; Future trends in sustainable development		

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

Learning Resources

1. Bowers, J. (1997). Sustainability and Environmental Economics. Longman, Singapore.
2. Brown, L. R. (2001). Eco-Economy. Earth Scan Publications, London.
3. Hackett, S. C. (1998). Environmental and Natural Resource Economics. M. E. Sharpe, London
4. Hanley, Nick; Spash, Clive L., (1993). Cost-benefit analysis and the environment, Edward Elgar.
5. Heal. G. M. (1998). ―Interpreting Sustainability‖ in Sustainability: Dynamics & Uncertainty, Kluwer Academic Publ., 34-44
6. Jepma C.J. & M. Munasinghe, (1998). Climate Change Policy – Facts, Issues and Analysis, Cambridge University Press, – Chapters 1 & 8. 110-159
7. Karpagam, M. (1991). Environmental Economics. Sterling Pub., New Delhi
8. Mohan Munasinghe, (1996). ―Sustainable Energy Development: Issues and Policy‖ – in Kleindorfor P. R. et. al (ed.) Energy, Environment and Economy: Asian Perspective, Edward Elgar, 45-65.
9. Muralivallabhan T. V., Dimensions of Sustainable Economic Development, Unma Pub., 2005
10. Murty, M.N.; James, A.J. & Misra, Smita, (1999). Economics of water pollution: the Indian experience, Oxford University Press.
11. Natalia Mirovitskaya and William Ascher., Guide to Sustainable Development and Environmental policy., Duke University Press, London, 2001.
12. Owen, L and Unwin, T. (Ed.). (1997). Environment Management. Backwell Pub., USA.
13. Pearce, David; Barbara, Edward, (2000). Blueprint for a sustainable economy, Earthscan, Publications Ltd.
14. Perch, David W.; Warford, Jeremy J., (1993).World without end: economics, environment, and sustainable development, Oxford University Press,
15. Rajyalakshmi V ., Environment and sustainable development ,A.P.H Pub, New Delhi
16. Rosencranz, A., Divan, S. and Noble, M. L. (1992). Environmental Law and Policy in India - cases, materials and statutes. Tripathi Pvt. Ltd., Bombay.
17. Savitha Singh, Global Concern with Environmental crisis and Gandhi‘s Vision (1999), APH Publishing Corporation, Delhi.
18. Schumacher, E. F. (1990). Small is Beautiful. Rupai & Co. Pub., New Delhi
19. Shankar V. (Ed) (2000): Environmental Economics, Oxford University, Press, New Delhi.
20. Titanberg, T. (1998). Environmental Economics and Policy (2nd Edn.). Addison Wesley Publishers.
21. Van den Bergh, Jereon C.J.M., (1996). Ecological economics and sustainable development: theory, methods and applications, Edward Elgar, 1996.

	MAHATMAGANDHIUNIVERSITY **Graduate School**

	4+1IntegratedUGandPGProgramme **ENVIRONMENTAL SCIENCE**

School Name	Graduate School		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Name	**Fundamentals of Disaster Management**		
Type of Course	MDC		
Course Level	200 – 299		
Course Code	**MG3MDCUES202**		
Course Overview	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.		
Semester	**3**	**Credit**	**3**
Total Student Learning Time (SLT)	**Instructional hours for theory**	**Instructional hours for practical/lab work//fieldwork**	
	45		
Pre-requisite			

CO No.	*At the end of the course, the student will be able to:*	Taxonomic Level (TL)	PSO
1.	Explain the relation between Earth‘s processes and disasters	U	1,7
2	Distinguish various types and causative factors of disasters	An	2,3
3.	Illustrate the key concepts of disaster management	U	5,7
4	Analyse the International disaster management system	An	6,7
5	Assess the disaster management strategies in India	E	4,5

COURSE CONTENT

		CO NO
Module 1: Environment and Disasters	**10 Hours**	1
Science and Facts of Natural Hazards. Earth's processes as disasters: internal and external Causal factors and characteristics of disasters. Climate change and Disasters		
Module 2: Types and Classification of Disasters	**10 Hours**	2
Natural Disasters: Meteorological disasters, Geological disasters, Biological disasters Anthropogenic Disasters: Chemical, Industrial and Nuclear related disasters, Accident-related Disasters		
Module 3: Disaster Management Concepts	**8 Hours**	3
Introduction to key concepts, terminologies and their complexities; Hazard, vulnerability, Exposure, Risk, Crisis, emergencies, Vulnerability, Disasters, Resilience Disaster management Spectrum and its components Scope of DM and Disaster Management Cycle		
Module 4: International Disaster Management System	**10 Hours**	4
Organisations, bodies and Finance. International Strategies and Functions. Role of United Nations in Disaster Management. International Disaster Management Support System. Unified response strategy. Mapping Disasters using global datasets. National and international information networks and inventories		
Module 5: Disaster Management in the Indian Context	**7 Hours**	5
Major Disasters in India. National Vulnerability profile National Disaster Management Hierarchy and Institutionalisation National Disaster Decision support system. Technological applications. Role of research organisations. Challenges of disasters in India		

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

Learning Resources

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,
3. Shaw R and Krishnamurthy R.R., (ed.) 2009. Disaster management Global Challenges and Local solutions. University Press, India
4. Keller E.D., and Blodgett R. H, 2006.Natural Hazards. Pearson Printice Hall
5. Kapur A., Neeti, Meena, Deepthima, Roshani and Debanjali, Disasters in India Studies of Grim Reality. Rawat Publications, New Delhi

	MAHATMAGANDHIUNIVERSITY **Graduate School**
	4+1IntegratedUGandPGProgramme **ENVIRONMENTAL SCIENCE**

School Name	Graduate School		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Name	**Climate Change**		
Type of Course	MDC		
Course Level	200 – 299		
Course Code	**MG3MDCUES203**		
Course Overview	This course is designed to provide a comprehensive idea on climate change including the drivers, impacts and mitigation strategies.		
Semester	**3**	**Credit**	**3**
Total Student Learning Time (SLT)	**Instructional hours for theory**	**Instructional hours for practical/lab work//fieldwork**	
	45		
Pre-requisite			

CO No.	***At the end of the course, the student will be able to:***	**Taxonomic Level (TL)**	**PSO**
1.	Describe the basics of Climate Change and explains the changes occurred so far and prediction of the future changes	U, R	1,7
2	Explain the causes of climate change and analyses the impacts of climate change	U,R,A	2,3
3.	Explain various procedures of inventorying the greenhouse gas emissions (GHG).	U,A,E	3,5
4	Evaluate long term mitigation pathways.	A	4,6

5	Explain various climate change adaptation methods, integrated natural resource management systems; evaluate various information systems including early warning systems.	U,A,R	2,5
6	Explain the global action and governance for climate change mitigation	U, R,C	6,7
7	Describe various technical and financial aids for climate change mitigation and adaptation	U	6, 5

COURSE CONTENT

		CO NO
Module 1: Basic definitions	**5 Hours**	1, 2
Climate and weather; climate change; greenhouse gases; radiative forcing; warming potential Climate modelling; global and regional circulation models; IPCC modelling scenarios.		
Module 2: Observed and projected changes in the climate system	**5 Hours**	1, 2
Land surface temperature; ocean surface temperature; precipitation; cryosphere; sea level Greenhouse gas (GHG) concentrations (CO_2 and non-CO2 gases); and extreme climatic events.		
Module 3: Drivers of climate change	**7 Hours**	3
Natural and anthropogenic radioactive forcing; solar irradiance; aerosols, water vapour and clouds; volcanic eruption GHG emissions from energy, industries, and transport; and gross and net emissions from agriculture, forestry and other land use.		
Module 4: Impacts of climate change	**8 Hours**	4
Physical systems (Glaciers, snow, ice and/or permafrost; Rivers, lakes, floods and/or drought; Coastal erosion and/or sea level effects) Biological systems (Terrestrial ecosystems; aquatic ecosystems); Human and managed systems (Food production; Livelihoods, health and/or economics)		
Module 5: Greenhouse gas inventorying	**7 Hours**	5
IPCC guidelines on national greenhouse gas inventorying; general guidance and reporting; guidance specific to energy Industrial processes and product use (IPPU), agriculture, forestry and other land use (AFOLU), and waste; activity data Emission factors; key categories; tiered approach; stock-difference and gain-loss methods; principles of reporting; measurement, reporting and verification (MRV) system.		
Module 6: Climate change mitigation	**7 Hours**	6,7
Decarbonising energy production; use of clean energy and enhancing the energy efficiency in industries, transport, and buildings; carbon dioxide storage and capture Bioeconomy or low carbon economy; enhancing the carbon sequestration capacity of forests and land use; climate-smart agriculture; REDD+, long-term mitigation pathways		
Module 7: Climate change adaptation	**6 Hours**	6,7

Social, ecological asset and infrastructure development Technological process optimisation; integrated natural resources management; institutional, educational and behavioural change or reinforcement Financial services, including risk transfer and information systems to support early warning and proactive planning.	

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	Continuous Internal Assessment (CIA) • Assignments • Seminar Presentation on selected topics • Quiz • Class tests Semester End examination

Learning Resources

1. Angelsen, A., Brockhaus, M., Sunderlin, W.D., &Verchot, L.V. (2012). Analysing REDD+: Challenges and choices. Centre for International Forestry Research (CIFOR). Bogor, Indonesia.426p.
2. Bonan, G.B. (2008). Forests and Climate Change: Forcing‘s, Feedbacks, and the Climate Benefits of Forests. *Science, 320*, 1444-1449.
3. *Ecosystem Marketplace (2015). Ahead of the Curve: State of the Voluntary Carbon Markets 2015*, Forest Trends, Washington DC, United States. pp 55.
4. IPCC (2006) 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., and Buendia L., Miwa K., Ngara T. and Tanabe K. (Eds) .Published: IGES, Japan.
5. IPCC (2008) 2006 IPCC Guidelines for National Greenhouse Gas Inventories – A primer, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Miwa K., Srivastava N. and Tanabe K. (Eds).Published: IGES, Japan.
6. IPCC (2013) Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
7. IPCC (2014) Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea,T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken,P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32.
8. IPCC (2014) Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (Eds.)]. IPCC, Geneva, Switzerland, 151 pp.

9. IPCC (2014) Summary for Policymakers, In: Climate Change 2014, Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer,O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B.Kriemann, J. Savolainen, S. Schlomer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
10. Intergovernmental Panel on Climate Change. (2023). *Climate Change 2023: Synthesis Report*.
11. Lenton, T., M., Held, H., Kriegler, E., Hall Jim, W., Lucht, W., Rahmstorf, S., &Schellnhuber Hans, J. (2008). Tipping elements in the Earth's climate system. *Proceedings of the National Academy of Sciences of the United States of America, 105*, 1786-1793.
12. Loarie, S.R., Duffy, P.B., Hamilton, H., Asner, G.P., Field, C.B., & Ackerly, D.D. (2009). The velocity of climate change. *Nature, 462*, 1052-1055.
13. Pal, J.S., & Eltahir, E.A.B. (2016). Future temperature in southwest Asia projected to exceed a threshold for human adaptability. *Nature Clim. Change, 6*, 197-200.
14. Parmesan, C., & Yohe, G. (2003). A globally coherent fingerprint of climate change impacts across natural systems. *Nature, 421*, 37-42.
15. Rosenzweig, C., Karoly, D., Vicarelli, M., Neofotis, P., Wu, Q., Casassa, G., Menzel, A., Root, T.L., Estrella, N., Seguin, B., Tryjanowski, P., Liu, C., Rawlins, S., &Imeson, A. (2008). Attributing physical and biological impacts to anthropogenic climate change. *Nature, 453*, 353357.
16. Scheffran, J., Brzoska, M., Kominek, J., Link, P.M., & Schilling, J. (2012). Climate Change and Violent Conflict. *Science, 336*, 869-871.
17. Shindell, D., Kuylenstierna, J.C.I., Vignati, E., van Dingenen, R., Amann, M., Klimont, Z., Anenberg, S.C., Muller, N., Janssens-Maenhout, G., Raes, F., Schwartz, J., Faluvegi, G., Pozzoli, L., Kupiainen, K., Höglund-Isaksson, L., Emberson, L., Streets, D., Ramanathan, V., Hicks, K., Oanh, N.T.K., Milly, G., Williams, M., Demkine, V., & Fowler, D. (2012). Simultaneously Mitigating Near-Term Climate Change and Improving Human Health and Food Security. *Science, 335*, 183-189.
18. Thomas, C.D., Cameron, A., Green, R.E., Bakkenes, M., Beaumont, L.J., Collingham, Y.C., Erasmus, B.F.N., de Siqueira, M.F., Grainger, A., Hannah, L., Hughes, L., Huntley, B., van Jaarsveld, A.S., Midgley, G.F., Miles, L., Ortega-Huerta, M.A., Townsend Peterson, A., Phillips, O.L., & Williams, S.E. (2004). Extinction risk from climate change. *Nature, 427*, 145-148.

	MAHATMAGANDHIUNIVERSITY **Graduate School**
	4+1IntegratedUGandPGProgramme **ENVIRONMENTAL SCIENCE**

School Name	Graduate School		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Name	**Carbon Footprint Analysis**		
Type of Course	VAC		
Course Level	200 – 299		
Course Code	**MG3VACUES201**		
Course Overview	The course aims to provide learners with the skills and knowledge necessary to calculate, analyse, and report carbon footprints for organizations, products, and services. Students will understand the principles, methodologies, and global frameworks for carbon quantification and develop strategies for reducing emissions and achieving Net Zero targets.		
Semester	**3**	**Credit**	**3**
Total Student Learning Time (SLT)	**Instructional hours for theory**	**Instructional hours for practical/lab work//fieldwork**	
	45		
Pre-requisite			

CO No.	***At the end of the course, the student will be able to:***	**Taxonomic Level (TL)**	**PSO**
1.	Explain the science of climate change and the role of greenhouse gases in global warming.	U	1,7
2	Understand global frameworks and national policies driving carbon footprinting and emissions reduction.	U	6,7
3.	Apply principles and techniques for carbon quantification, including setting organizational boundaries and inventorying emissions.	Ap	3,5

4	Evaluate and report carbon data effectively, adhering to global standards.	E	4,6
5	Develop and implement strategies for emissions reduction and align them with Net Zero goals.	C	4,5,6

COURSE CONTENT

		CO NO
Module 1: Introduction to Carbon Footprint Analysis	**8 Hours**	1, 2
Overview of climate change science and mechanisms; Greenhouse gases (GHGs) and their global warming potentials; Impacts of climate change on businesses and supply chains; Key terminologies: carbon neutrality, sources/sinks, offsetting, Net Zero, emissions reduction/removals, Scopes 1-4		
Module 2: Drivers for Carbon Footprinting	**10 Hours**	2, 3
Global frameworks: UNFCCC, IPCC, Paris Agreement, CoPs and Science-Based Targets (SBTi). National policies and mechanisms: NDCs, CDM, Committee on Climate Change (CCC), UK Net Zero Strategy, carbon budgets, and emissions trading. Interrelationship between climate change and sustainability frameworks – UNSDG, GRI etc. Stakeholder and supply chain pressures on organizations.		
Module 3: Carbon Quantification Standards and Schemes	**10 Hours**	3
Overview of key frameworks and standards: GHG Protocol, ISO 14064, CDP UK regulatory schemes - SECR, ESOS. Sector-specific codes and standards – BRC, GHG Protocol guides Differences between organizational, product, and project quantification.		
Module 4: Principles and Techniques of Carbon Footprinting	**8 Hours**	**4**
Principles: relevance, completeness, consistency, transparency, and accuracy. Developing a foot printing strategy: organisational boundaries and GHG inventory. Understanding GHG Scopes 1-3 and emerging Scope 4 (avoided emissions). Methods for calculating emissions; activity data, emission factors, and Scope 3 data hierarchy. Managing data quality and ensuring year-on-year consistency.		
Module 5: Communicating Carbon Data	**9 Hours**	4,5
Effective internal and external reporting methods. Reporting frameworks: ISO 14001, CDP, SECR. Using normalized data and financial arguments (ROI, life-cycle costing). Importance of verification and transparency in communication. The role of carbon footprints in emissions reduction and transition planning.		

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

Learning Resources

1. AccountAbility. (2018). *AA1000 Assurance Standard (AA1000AS v3)*. AccountAbility. https://www.accountability.org
2. Carbon Disclosure Project. (2022). *CDP Climate Change Reporting Guidelines*. CDP. https://www.cdp.net
3. CDP. (2022). *CDP Guidance for Companies: Climate change reporting framework*. https://www.cdp.net/en/guidance
4. Committee on Climate Change. (2020). *The Sixth Carbon Budget: The UK's path to Net Zero*. https://www.theccc.org.uk/publication/sixth-carbon-budget/
5. GHG Protocol. (2004). *The Greenhouse Gas Protocol: A corporate accounting and reporting standard* (Revised Edition). World Resources Institute and World Business Council for Sustainable Development. https://ghgprotocol.org/corporate-standard
6. Global Sustainability Standards Board. (2016). *GRI 305: Emissions 2016*. Global Reporting Initiative. https://www.globalreporting.org
7. Institute of Environmental Management and Assessment (IEMA). (2023). *Pathways to Net Zero Course Resources*. IEMA. https://www.iema.net
8. Intergovernmental Panel on Climate Change. (2023). *Climate Change 2023: Synthesis Report*. https://www.ipcc.ch/report/ar6/syr/
9. International Integrated Reporting Council. (2021). *The International <IR> Framework*. Value Reporting Foundation. https://integratedreporting.org
10. International Organization for Standardization. (2016). *ISO 14001:2015: Environmental management systems — Requirements with guidance for use*. https://www.iso.org/standard/60857.html
11. International Organization for Standardization. (2018). *ISO 14064-1:2018: Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals*. https://www.iso.org/standard/66453.html
12. International Organization for Standardization. (2018). *ISO 26000:2010: Guidance on social responsibility*. https://www.iso.org/standard/42546.html

13. Principles for Responsible Investment. (2021). *PRI Reporting Framework 2021*. Principles for Responsible Investment. https://www.unpri.org
14. Science Based Targets Initiative. (2021). *Foundations for science-based net-zero target setting in the corporate sector*. https://sciencebasedtargets.org/resources/files/Net-Zero-Foundations-paper.pdf
15. Sustainability Accounting Standards Board. (2021). *SASB Standards: Industry-specific standards for sustainability disclosure*. Value Reporting Foundation. https://www.sasb.org
16. Task Force on Climate-related Financial Disclosures. (2017). *Final report: Recommendations of the Task Force on Climate-related Financial Disclosures*. Financial Stability Board. https://www.fsb-tcfd.org
17. United Nations Framework Convention on Climate Change. (2015). *The Paris Agreement*. https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement
18. United Nations Global Compact. (2021). *Communication on Progress (CoP) reporting guidelines*. https://www.unglobalcompact.org
19. United Nations. (2015). *Transforming our world: The 2030 Agenda for Sustainable Development*. https://sdgs.un.org/2030agenda Global Reporting Initiative. (2021). *GRI Standards: Consolidated set of GRI sustainability reporting standards*. Global Reporting Initiative. https://www.globalreporting.org

SEMESTER IV

	MAHATMAGANDHIUNIVERSITY **Graduate School**
	4+1Integrated UG and PG Programme **ENVIRONMENTAL SCIENCE**

School	**Graduate School**		
Programme	**4+ 1 Integrated UG and PG Programme**		
Course Title	**Environmental Monitoring and Assessment**		
Course Type	**Major**		
Course Level	**200-299**		
Course Code	**MG4DSCUEN201**		
Course Overview	The course is directed at measuring, modeling and assessing the parameters of environmental quality for the purpose of environmental risk assessment. The course introduces the concept of environmental fate and transport and the methods to apply them in environmental risk assessment. The course also discusses the monitoring methods in the context of environmental fate and transport.		
Semester	**4**	**Credit**	**4**
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/labwork//fieldwork**	
	60	15	
Pre-requisite	Basic knowledge of Environmental samples		

COURSE OUTCOMES(CO)

CO No.	Expected Course Outcome	Taxonomic Level (TL)	PSO No.
	Upon completion of this course, students will be able to;		
1	Ability to demonstrate sound understanding of analytical techniques applied in environmental analyses	U	2
2	Ability to deal with QA/QC of analytical protocols	A	2,3
3	Ability to demonstrate sound understanding of analytical techniques applied in environmental analyses.	U, A	4
4	Building the foundation for understanding Remote Sensing and Geographic Information System (RS-GIS) as a powerful tool for geospatial analysis.	Ap	5

COURSE CONTENT

		CO NO
Module1: Environmental Monitoring	15 Hours	1, 3
What is environmental quality? Quality of environment for life on earth and man; Advantages of Environmental Monitoring, Deterioration of environmental quality with reference to anthropogenic impact; Methods of assessment of environmental quality and understanding of analytical techniques in environmental analyses; Short-term studies/surveys; Rapid assessment; Continuous short- and long-term monitoring.		
Module2: Pollution monitoring -Strategies and Procedures	15 Hours	1,2
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.		
Module3: Pollution monitoring parameters	15 Hours	1,3
Water quality parameters- physical, chemical and biological analysis; Water quality standards; Tracers – dyes and isotopes in pollution monitoring; Ambient Air Quality Monitoring; Air quality standards- ambient and emission, and Air Sampling equipment. Methods of monitoring and controlling air pollution SO2, NO, CO, CO2, Ozone, SPM-PM2.5 & PM 10. Air quality index. Soil/sediment sampling and monitoring. soil quality standards. Methods for assessing pollutant contamination profile in the sediments – chronology and pollutant detection		
Module4: Sample Analysis	15 Hours	1,3,4
Water Analysis- Colour, turbidity, conductivity, TDS, TSS, TS, pH, acidity, alkalinity, chloride, salinity, hardness, DO, BOD. Analysis of COD, Sulphate, Sulphide, Potassium, Iron . Nutrient analysis (Nitrite, Nitrate, TN, Phosphate), Total and dissolved metals in water Soil Analysis- Physical (Texture, Bulk density, moisture content) and chemical parameters (pH, OC/OM, EC), Available Nitrogen, Total Nitrogen, Available Phosphorous, Available potassium, Trace metals Air quality -Ambient Gaseous pollutant analysis – SOx, NOx, CO. Ambient particulate monitoring – SPM, RPM. Online monitoring of ambient air quality		

Mode of Transaction	**Classroom activities** **Field activities** **Lab based activities**

Mode of Assessment	Continuous Evaluation **Assignment/Quiz/Discussion/Seminar** **Internal Exam (40%)** **Final exam (60%)**

Learning Resources

1. D. P. Lawrence (2003) Environmental Impact Assessment: Practical Solutions to Recurrent Problems, John Wiley and Sons, New Delhi.
2. APHA (1995). Standard methods for the examination of water and wastewater. 19th edition American Public Health Association, Washington, DC
3. Abbasi S A, Water quality sampling and analysis, Discovery Publishing New Delhi
4. Maiti, S.K. (2003) Handbook of methods in environmental studies, Vol. 2: Air, noise, soil, overburden, solid waste and ecology. ABD Publishers, Jaipur

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	4+1Integrated UG and PG Programme **ENVIRONMENTAL SCIENCE**

School	**Graduate School**		
Programme	**4+ 1 Integrated UG and PG Programme**		
Course Title	**Biodiversity & Conservation biology**		
Course Type	**Major**		
Course Level	**200-299**		
Course Code	**MG4DSCUEN202**		
Course Overview	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.		
Semester	**4**	**Credit**	**4**
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/labwork//fieldwork**	
	60	15	
Pre-requisite	Basic knowledge about biotic factors of the environment.		

COURSEOUTCOMES(CO)

CO No.	**Expected Course Outcome** *Upon completion of this course, students will be able to;*	Taxonomic Level (TL)	**PSO No.**
1	Understand the basic concepts of Biodiversity and conservation biology	A	1
2	Study the distribution, significance and threats of biodiversity	U, An	2
3	Understand and evaluate the various initiatives for biodiversity conservation	U, E	1, 5
4	Understand and explain the concept of human ecology and natural history.	U, An	1, 6
5	Understand and analyse the legal and policy aspects of conservation science	U, An	6,7

COURSE CONTENT

		CO NO
Module1: Biodiversity - An introduction	13 Hours	1
The evolution of biodiversity. Theories and Concepts of Biodiversity. Origin of species/speciation. The distribution of biodiversity in macro scale. Species interactions and biodiversity. Values of Biodiversity – Direct and indirect use values, consumptive use value, productive use value, optional value,social value. Endemism, significance of the endemism.		
Module2: Threats to Biodiversity	13 Hours	1, 2
Threats to biodiversity: habitat loss, habitat fragmentation, deforestation, invasive species, over-exploitation, pollution and climate change, and Man-Wildlife conflicts. Ecological consequences of reduction in biodiversity, alien and invasive species, diseases, and pollution. Red data book and IUCN categories-criteria for categorization. Threatened species. Keystone species. A brief account of endangered flora and fauna of India.		
Module3: Biodiversity Conservation in Practice	13 Hours	1, 3
Historical perspective of conservation, Importance of conservation, Conservation and sustainable development, Role of CBD and MAB, Ecosystem people and traditional conservation mechanisms, In-situ conservation: Biosphere reserves, National parks, Wild life sanctuaries, Protected area management. Ex situ conservation: Botanical gardens, Zoological parks, Herbaria, cryopreservation, seed banks, gene banks.		
Module4: Introduction to Conservation Biology	8 Hours	1, 3, 4
History, Concepts and Background, Biogeography of India. Western Ghats, Basic understanding of common flora in Southern Western Ghats. Wild life biology. Restoration biology		
Module5: Conservation – Legal and policy framework	13 Hours	5
The Biological Diversity Act, 2002. Biological Diversity Rules, 2003. Intellectual Property Rights (IPR), TRIPS, Indigenous Knowledge Systems, The protection of plant varieties and farmer's rights (PVPFR) Act, 2001, 2007. Forest (conservation) Act, 1980 and its amendments. Wildlife Protection Act. National Green Tribunal Act 2010. National and International conservation policies and conservation challenges.		

Mode of Transaction	**Classroom activities** **Field activities** **Lab based activities**

Mode of Assessment	Continuous Evaluation **Assignment/Quiz/Discussion/Seminar** **Internal Exam (40%)** **Final exam (60%)**

Learning Resources

1. Sutherland, W. J. 2004. The Conservation Handbook, Research, Management and Policy, Blackwell Science ltd. P278.
2. Nair, S. C. Southern Western Ghats: A biodiversity conservation Plan, INTACH, New Delhi. P92.
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.
6. Maxted, N., B. V. Ford-Lloyd and J. G. Hawkes. 1997. Plant Genetic conservation- the insitu approach. Chapman & Hall, Madras.
7. Ahmadullah, M and Nayar, M. P. 1987. Endemic plants of the Indian Region. Vol. I Botanical Survey of India.
8. Heywood, V. H. (Ed) 1995. Global Biodiversity Assessment (UNEP), Cambridge, University Press, Cambridge.

	MAHATMAGANDHIUNIVERSITY **Graduate School**
	4+1Integrated UG and PG Programme **ENVIRONMENTAL SCIENCE**

School	**Graduate School**		
Programme	**4+ 1 Integrated UG and PG Programme**		
Course Title	**Natural and Anthropogenic Disasters**		
Course Type	**Major**		
Course Level	**200-299**		
Course Code	**MG4DSCUEN203**		
Course Overview	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.		
Semester	**4**	**Credit**	**4**
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/labwork//fieldwork**	
	60	15	
Pre-requisite	Basic knowledge about environmental disasters		

COURSE OUTCOMES(CO)

CO No.	**Expected Course Outcome** *Upon completion of this course, students will be able to;*	Taxonomic Level (TL)	**PSO No.**
1	Explain the relation between Earth‘s processes and disasters	U	1
2	Distinguish various types and causative factors of disasters	An	2
3	Concept of Disaster Preparedness and illustrate the key concepts of disaster management	U	5
4	Analyse the International disaster management system, Assess the disaster management strategies in India	An, E	5,7

COURSE CONTENT

		CO NO
Module1: Environment and Disasters	10 Hours	1, 2
Science and Facts of Natural Hazards. Earth's processes as disasters: Internal and external Characteristics. Causal factors and characteristics of disasters, Types of disasters		
Module 2: Natural Disasters	10 Hours	1, 2
Natural Disasters: Meteorological disasters & Geological disasters. Flood, Cyclone, Earthquakes, Landslides, Tsunami etc.		
Module 3: Anthropogenic Disasters	15 Hours	1, 2
Anthropogenic Disasters: Chemical, Industrial and Nuclear related Disasters, Accident-related Disasters (Air, Sea, Rail & Road). Biological Disasters, Structural failures (Building and Bridge), War & Terrorism etc. Causes, effects and practical examples for all disasters.		
Module 4: Disaster Management Concepts	15 Hours	3
Introduction to key concepts, terminologies and their complexities (Hazard, vulnerability, Exposure, Risk, Crisis, emergencies, Vulnerability, Disasters, Resilience). Organizations, bodies and Finance. International Strategies and functions. Role of United Nations in Disaster management. International Disaster management support system. Unified response strategy. Mapping Disasters using global datasets. National and international information networks and inventories.		
Module 5: Disaster Management in Indian Context	10 Hours	3, 4
Major Disasters in India. National Vulnerability profile. National Disaster management Hierarchy and Institutionalisation. National Disaster Decision support system. Technological applications. Role of research organisations. Challenges of disasters in India.		

Mode of Transaction	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

Mode of Assessment	Continuous Evaluation **Assignment/Quiz/Discussion/Seminar** **Internal Exam (40%)** **Final exam (60%)**

Learning Resources

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,
3. Shaw R and Krishnamurthy R.R., (ed.) 2009. Disaster management Global Challenges and Local solutions. University Press, India.
4. Keller E.D., and Blodgett R. H, 2006.Natural Hazards. Pearson Printice Hall
5. Kapur A., Neeti, Meena, Deepthima, Roshani and Debanjali, Disasters in India Studies of grim Reality. Rawat Publications, New Delhi

	MAHATMAGANDHIUNIVERSITY **Graduate School**
	4+1Integrated UG and PG Programme **ENVIRONMENTAL SCIENCE**

School	**Graduate School**		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Title	Waste Management		
Course Type	**Minor**		
Course Level	200-299		
Course Code	**MG4DSCUES241**		
Course Overview	The course provides an in-depth understanding of the principles, challenges, and strategies associated with waste management, focusing on sustainable practices and treatment technologies. Through theoretical learning and practical applications, students will explore various types of waste, their impacts on health and the environment, and effective management and disposal methods.		
Semester	4	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/fieldwork**	
	16	30	
Pre-requisite			

COURSE OUTCOME (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO
	Upon completion of this course, students will be able to;		
1	Understand the fundamental concepts of waste management, including types, sources, and impacts of solid and hazardous wastes on health and the environment.	U	1

2	Analyse municipal solid waste properties, identify appropriate collection, transportation, and disposal techniques, and evaluate treatment methods.	An, E	5
3	Assess the characteristics and classification of hazardous waste, develop management strategies for medical, nuclear, and radioactive wastes, and explore advanced treatment methods in alignment with Indian waste management regulations.	E	5
4	Develop a comprehensive understanding of Integrated Waste Management (IWM), including stakeholder roles, policy frameworks, and the waste management hierarchy, to propose sustainable solutions for waste challenges.	U	1,2

COURSE CONTENT

		CO NO
Module 1: Introduction to Waste Management	15 Hours	1
Definition and Importance of Waste Management; Types and Sources of Waste: Solid and Hazardous Waste; Impacts of improper Waste Management on Health and the Environment; Treatment Methods, chemical, biological and Advanced Treatment Methods; Concept of Three 'R's; Concept of Zero Waste.		
Module 2: Solid Waste Management	15 Hours	2
Municipal Solid Waste: Types, sources, properties and impacts; collection, transportation, disposal, processing of municipal solid wastes; Treatment methods: Incineration, landfilling, composting, vermicomposting.		
Module 3: Hazardous Waste Management	15 Hours	3
Hazardous waste: Characteristics and classification; Management of medical and hospital wastes, Nuclear and radioactive wastes-storage, collection, transport and disposal; Hazardous Waste Treatment-Physical, Chemical and Biological treatment; Hazardous Wastes Management in India.		
Module 4: Integrated Waste Management	15 Hours	4
Concepts and Principles of IWM; Waste management hierarchy; Role of Stakeholders-Government, Industries, Communities, NGO's; Waste management policies and framework.		

Mode of Transaction	**Classroom activities**
Mode of Assessment	**Assignment/Quiz/Discussion/Seminar** **Internal Exam (40%)** **Final Exam (70%)**

Learning Resources

1. Abbasi, S.A., Ramasamy, E.V. 2001. Solid Waste Management with Earthworms Discovery Publishing house, New Delhi.
2. Abbasi, S.A., Ramasamy, E.V. 2001. Solid Waste Management with Earthworms Discovery Publishing house, New Delhi.
3. Khan, M.K. 2004. Hospital waste Management: Principles and guidelines, Kanishka Publishers, New Delhi.
4. Kanti L. Shah (1999). Basics of Solid and Hazardous Waste Management Technology, Prentice Hall.
5. Metcalf and Eddy. 1991. Waste Water Engineering – Treatment, Disposal and Reuse. McGraw Hill International Edition, New York.

	MAHATMAGANDHIUNIVERSITY **Graduate School**
	4+1Integrated UG and PG Programme **ENVIRONMENTAL SCIENCE**

School	**Graduate School**		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Title	Biodiversity Assessment		
Course Type	SEC		
Course Level	200-299		
Course Code	**MG4SECUES201**		
Course Overview	The course provides an in-depth understanding of biodiversity and equips students with the skills and knowledge to assess, evaluate, and report biodiversity in various contexts, particularly in the realm of development projects and conservation initiatives. Practical techniques for biodiversity assessment and data analysis will be complemented by insights into report preparation for scientific and regulatory purposes, particularly within Environmental Impact Assessment (EIA) frameworks.		
Semester	4	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/fieldwork**	
	15	**30**	
Pre-requisite			

COURSE OUTCOME (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO
	Upon completion of this course, students will be able to;		
1	Demonstrate an understanding of biodiversity concepts, species interactions, levels of biodiversity, and the significance of biodiversity assessment in conservation.	U	1

2	Analyze the impact of development projects on biodiversity, interpret baseline data, and apply biodiversity assessment methodologies in Environmental Impact Assessments (EIA).	An	2
3	Apply biodiversity sampling methods, including quadrat techniques, transect sampling, wildlife census, and biodiversity indices, for assessing flora and fauna.	A	3
4	Prepare structured biodiversity assessment reports using advanced data analysis, visualization techniques, and tools like GIS, ensuring compliance with scientific and regulatory standards.	A	3

COURSE CONTENT

		CO NO
Module 1: Biodiversity- An introduction	4 Hours	1
Theories and Concepts of Biodiversity; Species interactions and biodiversity; Levels of Biodiversity; Threats to Biological Diversity; Endangered and Threatened species, IUCN, Red Data Book; Biodiversity Assessment – Significance in conservation		
Module 2: Biodiversity Assessment in Development Projects	4 Hours	2
Understanding the impact of development projects on biodiversity; Case studies: Biodiversity assessment in infrastructure, mining, and urban development projects; Baseline data collection and interpretation.		
Module 3: Assessment of Biodiversity	4 Hours	3
Indicators of Biodiversity; Biodiversity assessment: Quadrate method; Plotting large quadrates in Forests; Transect Sampling; Wild life Census; Collection of samples for plant and animal taxonomy; Biodiversity Indices (Simpson index, Shannon-Weiner index, Species richness).		
Module 4: Report Preparation - biodiversity	4 Hours	4
Structure and Components of a Biodiversity Report; Data Analysis and Visualization Techniques; Tools for Data Presentation: Remote Sensing and GIS; Writing Biodiversity Reports for Scientific and Regulatory Purposes. Compensatory afforestation		

Mode of Transaction	**Classroom activities** **Field activities** **Lab based activities**
Mode of Assessment	**Assignment/Quiz/Discussion/Seminar** **Internal Exam (40%)** **Final Exam (70%)**

Learning Resources

1. Begon, M., Townsend, C. R., & Harper, J. L. (2020). *Ecology: From Individuals to Ecosystems* (5th ed.). Wiley.
2. Sutherland, W. J. (Ed.). (2006). *Ecological Census Techniques: A Handbook*. Cambridge University Press.
3. Noss, R. F. (1990). Indicators for Monitoring Biodiversity: A Hierarchical Approach. *Conservation Biology*, 4(4), 355–364.
4. Jacobson, S. K. (2009). *Communication Skills for Conservation Professionals* (2nd ed.). Island Press.
5. Secretariat of the Convention on Biological Diversity (CBD). (2006). *Guidelines on Biodiversity in Impact Assessment*. UNEP.
6. Margules, C. R., & Sarkar, S. (2007). *Systematic Conservation Planning*. Cambridge University Press.

	MAHATMAGANDHIUNIVERSITY **Graduate School**
	4+1Integrated UG and PG Programme **ENVIRONMENTAL SCIENCE**

School	**Graduate School**		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Title	Environmental Analysis		
Course Type	VAC		
Course Level	200-299		
Course Code	**MG4VACUES201**		
Course Overview	The course provides with a comprehensive understanding of methods and techniques used to monitor, analyze, and assess various environmental components and emphasizes the importance of accurate environmental data in understanding pollution, managing natural resources, and informing policy and decision-making. Through theoretical knowledge and practical application, students will explore the principles of environmental monitoring, water, soil, and air quality analysis, and advanced analytical techniques.		
Semester	4	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/fieldwork**	
	30	30	
Pre-requisite			

COURSE OUTCOME (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO
	Upon completion of this course, students will be able to;		
1	Understand the scope, importance, and applications of environmental analysis in monitoring and managing key environmental components such as air, water, soil.	U	1
2	Identify and evaluate physical, chemical, and biological water quality parameters using appropriate sampling and	An, E	3

	analysis methods, and interpret results based on established standards and indices.		
3	Assess soil properties, including nutrients and heavy metals, through suitable analytical techniques, and understand their environmental implications on ecosystems and agricultural practices.	An, E	2
4	Analyze air quality parameters, including particulate and gaseous pollutants, using monitoring tools and apply air quality standards to assess environmental health risks.	An	2

COURSE CONTENT

		CO NO
Module 1: Environmental Analysis- Introduction	7 Hours	1
Definition and scope of environmental analysis; Importance of monitoring and analysis in environmental management; Key environmental components (air, water, soil); Overview of environmental pollution and degradation; Role of environmental analysis in policy and decision-making; Inorganic and Organic analysis.		
Module 2: Water Quality Analysis	8 Hours	2
Water quality parameters: physical-colour, temperature, odour, electrical conductivity, turbidity; chemical -pH, TDS, DO, BOD, Hardness, Alkalinity, Acidity, COD, Nitrate, Phosphate, Chloride and biological parameters- Total coliforms and faecal coliforms; Sampling methods for surface and groundwater; Water quality standards and indices.		
Module 3: Soil Quality Analysis	8 Hours	3
Soil properties and their environmental significance: physical- Texture, porosity, and bulk density; chemical- pH, organic carbon, nitrogen, phosphorus, potassium, heavy metals (Pb, Cd, Hg). and biological- microbial activity; Soil sampling and storage methods; Techniques for analysis of nutrients, contaminants, and heavy metals; Impact of soil degradation on ecosystems.		
Module 4: Air Quality Analysis	7 Hours	4
Air pollutants: Particulate matter (PM10, PM2.5), gaseous pollutants (SO2, NOx, CO, Ozone); Meteorological parameters and their role in air quality monitoring; Air Quality Index, Standards for ambient air quality (NAAQS and WHO).		

Mode of Transaction	**Classroom activities** **Field activities** **Lab based activities**
Mode of Assessment	**Assignment/Quiz/Discussion/Seminar** **Internal Exam (40%)** **Final Exam (70%)**

Learning Resources

1. Abbasi S A, Water quality sampling and analysis, Discovery Publishing New Delhi
2. APHA (1995). Standard methods for the examination of water and wastewater. 19th edition American Public Health Association, Washington, DC
3. Mamata Tomar, Quality Assessment of Water and Waste Water, Lewis Publishers London
4. Maiti, S.K. (2003) Handbook of methods in environmental studies, Vol. 2: Air, noise, soil, overburden, solid waste and ecology. ABD Publishers, Jaipur.
5. NEERI , Air quality monitoring, A course manual (Photostat), NEERI Nagpur