2020

SYLLABUS OF POSTGRADUATE PROGRAMMES

SCHOOL OF ENVIRONMENTAL SCIENCES

MAHATMA GANDHI UNIVERSITY

SCHEME OF THE SYLLABUS

MSc. Environment Science and Management

Credit and Semester System

2020 admission onwards

Semester I

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

Semester II

Sl. No.	Course Code	Name of the Course	Credits	Credits Required	Total Credits
11	SES MP C 11	Analytical Techniques and Instrumentation	3	12	22
12	SES MP C 12	Environmental Biotechnology and Waste Management	3		
13	SES MP C 13	Biodiversity and Conservation Biology	3		
14	SES MP C 14	Lab course-II (Environmental Chemistry, Environmental	3		

		microbiology, Biotechnology, RS & GIS)			
15	SES MP E 15	Environmental Laws, Ethics, Education and Policy	2	12/10	
16	SES MP E 16	Environmental Economics and Sustainable Development	2		
17	SES MP E 17	Ecotoxicology	2		
18	SES MP E 18	Green Chemistry and Nano Technology	2		
19	SES MP E 19	Fundamentals of Management	2		
20	SES MP E 20	Environmental Microbiology	2		

Semester III

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

Semester IV

Sl. No.	Course Code	Name of the Course	Credits	Credits Required	Total Credits
29	SES MP C 28	Project Work (Report/Thesis)	16	16	16

M.Sc. Environment Science and Management

SYLLABUS

Credit and Semester System

2020 admission onwards

MAHATMA GANDHI UNIVERSITY

Name of the Course : SES MP C 01
Ecology and Environment

School Name	School of Environmental Sciences						
Programme	M.Sc. Environment Science and Management						
Course Name	Ecology and Environment						
Type of Course	Core						
Course Code	SES MP C 01						
Names of Academic Staff & Qualifications	Dr. Sylas V.P., MSc., PhD						
Course summary & Justification	The course provides an insight into the						
Semester		**1**	**Credit**			**3**	
Total Student Learning Time (SLT)	**Learning approach**		**Lecture**	**Tutorial**	**Practical**	**Others**	**Total hrs**
							54
Pre-requisite	The students have basic understanding and readings on ecology and environmental science						

Unit	Course Description	Hours
1.0	**Introduction**	**11**
1.1	Basic concepts of Environment –	2
1.2	Multidisciplinary approach	2
1.3	Basic concepts - Science, Matter and Energy	2

1.4	Evolution of earth, origin of species, diversity and distribution of species	**3**
	Global environmental issues – an introduction	2
2.0	**Ecology**	**12**
2.1	Definition,History ofecology,Subdivisions,Ecologyandothersubjects.	2
	Fundamental ecologicalvariables	2
2.2	Ecosystems:Definition,Components,Structureandfunction,Sizeof Ecosystem,	3
2.3	Classificationof ecosystems	3
2.4	ComparativeEcosystemEcology	2
3.0	**PopulationEcology**	**10**
3.1	Definition,StructureandMeasures	2
3.2	PopulationGrowth,Population	2
3.3	Regulation Strategiesofspecies	**2**
3.4	Survivability PopulationGenetics	2
3.5	HumanPopulation	2
4.0	**CommunityEcology**	**10**
4.1	Concepts,Communitygradients,Charactersofcommunity	**2**
4.2	EcologicalSuccessionandclimaxCommunity	3
4.3	Organization Interactionsbetweenspecies	3
4.4	StressEcologyandAdaptation	2
5.0	**AppliedEcology**	**11**
5.1	EstimatingAbundanceSpeciesdiversitymeasures	2
5.2	Diversity indices	2

5.3	Mathematical ecology : Eco-informatics	2
5.4	Museology	1
5.5	TaxonomyandBiosystematics	2
5.6	Biomassproductivityandestimationtechniques	2

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 Assignments based on the theory Seminar Presentation Field visit report 2. Semester End examination

References

1. Brewer,R.(1994),TheScienceofEcology,SaundersCollegePublishing,NewYork.
2. Chapman, J. L. And Reiss, M. J. (19920, Ecology: Principles and Application, CambridgeUniversityPress,Cambridge.
3. Groombridge, B. (ed) 1992. Global Biodiversity: Status of the Earth's Living Resources,ChapmanandHall,London.
4. Hughes,J,D.2001.AnEnvironmentalHistoryoftheWorld.Routledge,London.
5. Michael,P.1990.EcologicalmethodsforLaboratoryandFieldInvestigations,Tata McGrew Hill PublishingCompanyLtd,NewDelhi.
6. Odum,E.P.1971.Fundamentals of ecology
7. Sutherland, W. J. 2004. 1997. Ecological CensusTechniques - A Handbook. CambridgeUniversityPress.P336.

MAHATMA GANDHI UNIVERSITY

Name of theCourse: SES MP C 02
Environmental Geosciences

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

Unit	Course Description	Hours
1	**The Earth as a System**	**9**
1.1	Earth in relation to Universe- Origin of the solar system-Geologic Times scale – The Geologic Record – Evolution of life	3
1.2	Earth as a System of Interacting Components –Lithosphere, atmosphere, Hydrosphere	2

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

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

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	Name of theCourse: SES MP C 02 **Environmental Geosciences**

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

References

1. Grotzinger et al 2007 Understanding Earth, WH Freeman New York , 579 p
2. Mukerjee, P.K. 2013 A Textbook of Geology, The World Press Pvt. Ltd, Kolkata, 638p
3. Duff and Holmes 2016 (third edition), Holmes Principles of Physical Geology, Cheltenham, England ; Nelson Thornes
4. Soman K 2001 Geology of Kerala Geological Society of India Bangalore 430 p.
5. Fetter CW 1990 Applied Hydrogeology CBS New Delhi 592 p
6. Stewart RH 2007 Introduction to Physical Oceanography 353 p

MAHATMA GANDHI UNIVERSITY

Name of the Course : SES MP C 03
Environmental Chemistry

School Name	School of Environmental Sciences					
Programme	M.Sc. Environment Science and Management					
Course Name	Environmental Chemistry					
Type of Course	Core					
Course Code	SES MP C 03					
Names of Academic Staff & Qualifications	Dr. C.T. Aravindakumar, MSc., PhD					
Course summary & Justification	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		**1**	**Semester**		**1**	
Total Student Learning Time (SLT)	**Learning approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	**Total hrs**
						60
Pre-requisite						

Unit	Course Description	Hours
1	**Man and environment**	
1.2	Water and the hydrosphere, Air and the atmosphere	**3**
1.3	Energy and cycles of energy, Chemical fate and transport.	**4**

2	**Chemistry of the environment - basics**	
2.1	Mass and Energy transfer across the various interfaces, material balance.	**4**
2.2	First and Second law of thermodynamics. heat transfer' processes, Chemical potential;. chemicalequiilibria, acid· base reaction.	**4**
2.3	Solubility product, solubility of gases in water, the carbonate system.	**3**
2.4	Unsaturated and saturated hydrocarbons, radionuclide's	**3**
3	**Atmospheric chemistry**	
3.1	The atmosphere Composition of Air : Classification of elements, chemical speciation. Particles, ions and radicals in the atmosphere.	**4**
3.2	Chemical and photochemical reactions in the atmosphere, reactions of atmospheric oxygen,	**4**
3.3	Chemical processes for formation of inorganic and organic particulate matter. Chemistry of air pollutants, Photochemical smog.	**4**
3.4	Energy transfer in atmosphere, Global climate and microclimate,	**3**
4	**Aquatic chemistry**	
4.1	Fundamentals of aquatic chemistry, The importance of water, The properties of water, gases in water	**4**
4.2	Calcium and other metals in water, Polyposhphates and phosphonates in water	**3**
4.3	Concept of DO, BOD, COD, sedimentation, coagulation,· filtration, Redox potential.	**4**
5	Soil Chemistry	**3**
5.1	Nature and decomposition of soil, Inorganic and organic	**3**

	components of soil,	
5.2	Acid base and ion exchange reactions in soils, macro and micronutrients in soil, Nitrogen pathways, NPK in soils.	**3**

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

References

1. 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, McGRAW 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)

MAHATMA GANDHI UNIVERSITY

Name of the Course :SES MP C 04
Environmental Pollution and Control

School Name	School of Environmental Sciences						
Programme	M.Sc. Environment Science and Management						
Course Name	Environmental Pollution and Control						
Type of Course	Core						
Course Code	SES MP C 04						
Names of Academic Staff & Qualifications	Dr. Mahesh Mohan , MSc., PhD						
Course summary & Justification	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		**1**	**Semester**			**1**	
Total Student Learning Time (SLT)	**Learning approach**		**Lecture**	**Tutorial**	**Practical**	**Others**	**Total hrs**
							60
Pre-requisite							

Unit	Course Description	Hours
1	**Air Pollution**	
1.1	Air Pollution – Definition and Sources - Natural and anthropogenic; Types of Pollutants- Primary and Secondary. Acid rain, Smog-	**2**

	Photochemical and Classical; Ozone depletion	
1.2	Factors affecting air pollution, Transport and diffusion of pollutants. Gas laws governing the behaviourof pollutants in the atmosphere.	**3**
1.3	Indoor air pollution – Types and sources of pollutants	**2**
1.4	Effects of pollutants on human beings, plants, animals, materials and on climate. Identification of aeroallergens. Air-borne diseases and allergies.	**3**
1.5	Air pollution control	**2**
1.6	Noise Pollution and control : Characteristics of noise, sources, Effects of noise, Standards, Measurement and control	**2**
2	**Water Pollution**	
2.1	Water Pollution - Types -surface and ground water, Surface water pollution-Sources – point and nonpoint, Types of pollutants – chemical, physical and biological	**3**
2.2	Chemical pollutants – inorganic (metals and other elements) and organic (POPs); Nutrients and Eutrophication, Organic matter - sources and degradation Biological pollutants Microbial pollution	**3**
2.3	Ground water pollution – sources and types of pollutants, Geological and athropogenic pollutants in ground water – Arsenic, Fluoride, Saline water intrusion etc. Movements of contaminants in ground water,	**3**
2.4	Coastal and Marine pollution-Oil spills, Thermal pollution, Impacts of water pollution	**2**

2.5	Heavy metals and other POPs in aquatic systems - cycling and interactions, Fate and transport of pollutants- factors affecting, Global oceanic transport of pollutants	**2**
2.6	Management of point and non-point sources of water pollution, water pollution control, Role of State and Central Pollution Control Boards	**2**
3	**Soil Pollution**	
3.1	Soil/sediment Pollution – sources and types, soil as a pollutant, Soil quality parameters-Physico-chemical parameters of soil quality, factors affecting pollutants in the sediments – texture, pH, redox potential, organic carbon etc.	**3**
3.2	Sedimentation rate and contamination profile, sediment pollution indices	**2**
3.3	Soil Pollution Control. Industrial waste effluents and heavy metals, their interactions with soil components. Soil micro-organisms and their functions, Degradation of different insecticides, fungicides and weedicides in soil. Different kinds of, synthetic fertilizers (NP & K) and their interactions with different components of soil.	**3**
4	Environmental Pollution monitoring	
4.1	Monitoring-online and offline, Environmental sampling and analysis – stages (sampling, treatment, detection and interpretation), scope and criteria , Sampling – water, air and soil, equipment for air, water and soil sampling. Analysis – types and methods, Speciation, Certified reference materials.	**4**
4.2	Water quality parameters-physical, chemical and biological, analysis, Water quality standards, Tracers – dyes and isotopes in pollution monitoring	**4**
4.3	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, SPM-PM2.5 & PM 10. Air quality index. Noise measurement	**3**

4.4	Soil/sediment sampling and monitoring. soil quality standards. Methods for assessing pollutant contamination profile in the sediments – chronology and pollutant detection	**2**
5	**Radioactive Pollution**	
5.1	Radioactivity in the environment, Radioactive Pollution: Radionuclides- sources, types of radiation, Radioactive fallout,	**2**
5.2	Ecological risks from radiation, effects on humans, exposure standards.	**2**
5.3	Control measures: radioactive waste treatment.	**2**
6	**Emerging contaminants**	
6.1	Emerging contaminants – definition, types and sources Sources and health impacts of PPCPs, POPS, PCCDS, PFAs, Dioxins, PCBs etc.	**2**
6.2	Plastics pollution in the freshwater and marine ecosystems Natural disasters and Pollution	**2**

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

References

1. Baxter, M. (2013). Social and Ethical Aspects of Radiation Risk Management, Vol.19, Editors: Deborah Oughton Sven Hansson. Elsevier (Pub.). Series: Radioactivity in the Environment.
2. Brady, N.C. (1996).The Nature and Properties of Soil, 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. Luyben, W. L. Process Modeling Simulation and Controls for Chemical Engineers, Mc. Graw Hill Book Co.
5. Mahajan, S.P. (1998). Pollution control in process industries, Tata McGraw Hill, New Delhi.
6. Masters, G.M. (1998). Introduction to Environmental Engineering and Science 3rd ed. Prentice Hall of India Pvt. Ltd.
7. Metcalf and Eddy (2003).Wastewater engineering: Treatment, Disposal, Reuse, 4th edition. Tata McGraw Hill, New Delhi.
8. Miller R.W. and Donalvee, R.L. (1997). Soils in Our Environment, 7th Ed, Prentice Hall of India Pvt. Ltd.
9. Nathanson, J.A. (2003). Basic Environmental Technology, 4th Ed., Prentice Hall of India Pvt. Ltd.
10. Parsons, S.A. and Jefferson, B. (2006). Introduction to potable water treatment processes, Blackwell Publishing.
11. Rao, C.S. (1995). Environmental Pollution Control Engineering, 3rd Ed., Wiley Eastern Ltd. New Age International Pvt. Ltd.
12. Sharma, B.K. (2001). Water Pollution. Goel Pub. House. Meerut.
    Wadhwa, Y. (2009). Air Pollution: Causes and Control. Cyber Tech Publications, New Delhi
13. Poonia and Sharma (2018)., Environmental Engineering, Khanna Books, ISBN: 9789386173577, 9386173573.
14. Helmut Meuser (2010).Contaminated Urban Soils, Springer.

Suggested readings

15. http://echo2.epfl.ch/VICAIRE/mod_2/chapt_9/main.htm
16. http://www.bis.org.in/
17. http://www.science.uwaterloo.ca/~cchieh/cact/applychem/watertreatment.html
18. http://www.sciencedirect.com/science/journal/02697491?sdc=1
19. http://www.water-pollution.org.uk/types.html
20. https://en.wikipedia.org/wiki/Water_pollution
21. https://link.springer.com/journal/11270

22. https://www.journals.elsevier.com/atmospheric-pollution-research/
23. https://www.journals.elsevier.com/environmental-pollution/
24. https://www.sciencedaily.com/terms/water_pollution.htm

MAHATMA GANDHI UNIVERSITY

Name of the course : SES MP C 05
Research Methodology and Statistics

School Name	School of Environmental Sciences					
Programme	M.Sc. ENVIRONMENT SCIENCE &MANAGEMENT & M.Sc. ENVIRONMENT SCIENCE & DISASTER MANAGEMENT					
Course Name	Research Methodology and Statistics					
Type of Course	Elective					
Course Code	SES MP C 05					
Names of Academic Staff & Qualifications	P. Padma, M.A., M.Phil., M.Ed.,					
Course summary & Justification	The course deals with the general research methodology and statistical practices for environmental sciences and disaster management.					
Semester		**1**	**Credit**		**3**	
Total Student Learning Time (SLT)	**Learning approach**		**Lecture**	**Tutorial**	**Practical**	**Others**	**Total hrs**
							54
Pre-requisite	Basic research aptitude and knowledge in statistics					

Teaching and Learning Approach	
Assessment Types	1. Continuous Internal Assessment (CIA) Internal test Assignment Seminar Presentation Mini project for data analysis 2. Semester End examination

References

1. Ahuja Ram, Research Methods, Rawath Jaipur.
2. Babbie Earl, Research methods in sociology, Cengage Learning Australia.
3. Denscombe Martyn, The good research guide: for small scale social research projects, Viva Books New Delhi.
4. Devendra Thakur, Research methodology in social science, Deep & Deep Publications New Delhi

5. Gurumani N, Research methodology for Biological Sciences, MJP Publishers Chennai
6. Holmes Debbie Moody Peter Dine Diana, Research methods for the biosciences, Oxford Newyork.
7. Kothari C R, Research methodology: methods and techniques, WiswaPrakashan New Delhi.
8. Mohankumar P S , Handbook on research methodology, Right Publishers Kudanechoor
9. Narwal S S Dahiya S S Singh J P, Research methods in Plant science, Allelopathy Vol 1, Soil analysis, Scientific Publishers Jodhpur.
10. Prabhakar V K, Research methodology and system analysis, Anmol NewDelhi
11. Santosh Gupta, Research methodology and statistical techniques, Deep & Deep Publications New Delhi
12. Barnett Vic, Environmental statistics, methods and applications. JhonWiley& Sons NewYork.
13. Gupta S P, Statistical methods, Sultan Chandh New Delhi
14. Kozak Antal Kozak Robert AStaudhammer Christina L Watts Susan B, Introductory Probability and Statistics, applications for forestry and the natural sciences, Cab International Wallingford.
15. Levin Richard I Rubin David S, Statistics for Management, Edition 7, P H I NewDelhi
16. Miller Jane, Statistics for advanced level, Ed.2, University Press Cambridge.

MAHATMA GANDHI UNIVERSITY

Name of the Course: SES MP C 06
Lab course-I (EnvironmentalChemistry, Geosciences and Ecology)

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

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Name of the Course: SES MP C 06
Lab course-I (EnvironmentalChemistry, Geosciences and Ecology)

Unit	Course Description	Hours
1	**Environmental Chemistry**	**13**
1.1	Volumetric Analysis: Basic Principles	4
1.2	Acidimetry and Alkalimetry—Estimation of hydrochloric acid, sodium carbonate, oxalic acid	3
1.3	Permanganometry- Mohrs salt, potassium permanganate	4
1.4	Gravimetric analysis	2
2	**Water and Noise quality**	**12**
2.1	Colour, turbidity, conductivity, TDS, TSS,TS, pH, acidity, alkalinity, chloride, salinity, hardness, DO, BOD	10
2.2	Noise analysis	2
3	**Ecology**	**14**
3.1	Biodiversity assessment : Quadrate method	6
3.2	Plankton analysis	4
3.3	Zooplankton analysis	4
4	**Environmental Geosciences**	**21**
4.1	Identification of rocks and minerals	6
	Soil analysis- Physical (Texture, Bulk density, moisture content) and chemical parameters (pH, OC/OM, EC)	8
4.2	Rose diagrams- Wind rose	4
4.3	Measuring strike and dip of rock formations. Basic map reading.	3

	MAHATMA GANDHI UNIVERSITY
	Name of the Course: SES MP C 06 **Lab course-I (EnvironmentalChemistry, Geosciences and Ecology)**

Teaching and Learning Approach	
Assessment Types	1. Continuous Internal Assessment (CIA) Internal test 2. Semester End examination

References

1. APHA (1995).Standard methods for the examination of water and wastewater. 19th edition American Public Health Association, Washington, DC
2. Abbasi S A, Water quality sampling and analysis, Discovery Publishing New Delhi
3. Christian Gary D, Analytical Chemistry, JhonWiley& Sons NewYork.
4. Conklin Alfred R. Introduction to Soil chemistry, analysis and Instrumentation, Jhonwiley&SonsNewyork
5. Maiti, S.K. (2003) Handbook of methods in environmental studies, Vol. 2: Air, noise, soil, overburden, solid waste and ecology. ABD Publishers, Jaipur.
6. Marc Pansu, Jacques Gautheyrou, Hand book of soil analysis- Minerological, organic and inorganic methods, Springer, New York
7. Maria Csuros and CsabaCsuros, Environmental Sampling and Analysis for Metals, Lewis Publishers
8. MiroslavRadojevic and Vladimir N Bashkin, Practical Environmental Analysis, RSC Publishing
9. MamataTomar, Quality Assessment of Water and Waste Water, Lewis Publishers London
10. NEERI , Air quality monitoring, A course manual (Photostat), NEERI Nagpur.

MAHATMA GANDHI UNIVERSITY

Name of the course: SES MP E 07
Disasters and its Management

School Name	School of Environmental Sciences						
Programme	M.Sc. Environment Science and Management						
Course Name	Disasters and its management						
Type of Course	Elective						
Course Code	SES MP E 07						
Names of Academic Staff & Qualifications	Dr. Baiju K.R. MSc., PhD						
Course summary & Justification	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		**1**	**Credit**			**2**	
Total Student Learning Time (SLT)	**Learning approach**		**Lecture**	**Tutorial**	**Practical**	**Others**	**Total hrs**
							36
Pre-requisite							

MAHATMA GANDHI UNIVERSITY

Name of the course: SES MP E 07
Disasters and its Management

Unit	Course Description	Hours
1.	**Environment and Disasters**	7
1.1	Science and Facts of Natural Hazards. Earth's processes as disasters: Internal and external	3
1.2	Characteristics. Causal factors and characteristics of disasters.	2
1.3	Climate change and Disasters	2
2	**Types and Classification of Disasters**	**8**
2.1	Natural Disasters: Meteorological disasters, Geological disasters, Biological disasters	4
2.1	Anthropogenic Disasters: Chemical, Industrial and Nuclear related Disasters, Accident related Disasters	4
3.	**Disaster Management Concepts**	**6**
3.1	Introduction to key concepts, terminologies and their complexities (Hazard, vulnerability, Exposure, Risk, Crisis, emergencies, Vulnerability, Disasters, Resilience)	3
3.2	Disaster management Spectrum and its components Scope of DM and Disaster Management Cycle	3
4	**International Disaster management System**	**7**
4.1	Organizations, bodies and Finance. International Strategies and functions. Role of United Nations in Disaster management.	3
4.2	International Disaster management support system. Unified response	2

	strategy.	
4.3	Mapping Disasters using global datasets. National and international information networks and inventories	2
5	**Disaster Management in Indian Context**	**8**
5.1	Major Disasters in India. National Vulnerability profile	2
5.2	National Disaster management Hierarchy and Institutionalisation	2
5.3	National Disaster Decision support system. Technological applications. Role of research organisations.	2
5.4	Challenges of disasters in India	2

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

References

1. 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 UsingGlobal Datasets Natural Hazards Volume 35, Number 2, 265-289,

3. Shaw R and Krishnamurthy R.R., (ed.)2009. Disaster management Global Challenges andLocal 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

MAHATMA GANDHI UNIVERSITY

Name of the Course: SES MP E 08
Energy Resources

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

Unit	Course Description	Hours
1	**Fundamentals of Energy System**	**7**
1.2	Flow of energy and cycle of matter in the human ecosystem: Energy for household, industrial and agricultural uses.	2
1.3	History and geography of energy development and energy related pollution; Concepts of Conventional, Non-conventional, Renewable, Non-renewable and Alternate energy resources	2
2	**Non-Renewable Energy Resources**	**16**
2.1	Fossil fuels: Coal, Pete, Oil, Oil shale, Tar sands, Natural gas	8

2.2	Non-fossil fuels: Nuclear power; Ecological and social impacts (Advantages and Disadvantages) of major thermal and nuclear power plants	6
2.3	Management of energy projects and its environmental impacts Environmental impacts of non-renewable energy resources	2
3	**Renewable Energy Resources**	**16**
3.1	Solar Energy: Technique for harvesting solar energy, direct utilization of solar energy by thermal conversion thermo-mechanical conversion, Helio-electric conversion, Photo-voltaic conversion, indirect utilization through water power- Ocean Thermal Energy Conversion (OTEC), Solar ponds	6
3.2	Wind resources: Mapping of wind resources area, wind power stations, wind turbines – types, efficiency: Betz limit Geothermal sources, Tidal energy and Ocean waves- Possibilities and limitations	6
3.3	Biomass based energy- Biogas systems, petro-plants, dendrothermal energy Environmental impacts of renewable resources	4
4	**Energy Resources Indian Status**	**6**
4.1	Fuel wood resources in India Fossil fuel- coal, oil natural gas – National status	2
4.2	Hydropower in the country Nuclear power in India	2
4.3	Renewable energy resources in India: Thermal energy, solar energy, wind energy,biomass based energy and other renewable energy	2

	sources (tidal, ocean waves and geothermal)	
5	**Energy Related Environmental Issues**	**2**
5.1	Environmental pollution associated with energy generation and consumption process Energy pricing techniques for controlling environmental problems (air pollution)	2
6	**Energy Audit**	**3**
6.1	Types of audits- walk through energy audit, intermediate energy audit,and comprehensive energy audit Recommended practices	2
6.2	Performing the energy audit- details- computer simulation, developing the report	1

Teaching and Learning Approach	
Assessment Types	1. Continuous Internal Assessment (CIA) • Assignments • Seminar Presentation on selected topics • Quiz • Class tests 2. Semester End examination

References

1. J.Twidell and T. Weir, Renewable Energy Resources, Taylor& Francis, 2006.

2. K.M. Mittal, Non-conventional Energy Systems-Principles, Progress and Prospects, Wheeler Publications, 1997

3. G.D. Rai, Non-conventional Energy Sources, Khanna Publishers, 2003

4. TERI Energy Data Directory & Year Book (TEDDY). (1997). Tata Energy Research Institute (TERI), New Delhi

5. McKinney, M. and Schoch, R.M. 1998. Environmental Sciences: System and solutions. Johnes and Bartlett publishers, Massachusetts

6. Biomass Energy Systems (1997). Tata Energy Research Institute (TERI), New Delhi

7. Looking back to think ahead: Green India 2047. (1998). Tata Energy Research Institute (TERI), New Delhi

MAHATMA GANDHI UNIVERSITY

Name of the course: SES MP E 09
Nature Studies – Field skills and Techniques

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

MAHATMA GANDHI UNIVERSITY

Name of the course: SES MP E 09
Nature Studies – Field skills and Techniques

Unit	Course Description	Hours
1	**Water quality Monitoring**	**12**
1.1	Water sampling	4
1.2	Sediment sampling	2
1.3	Sampling of planktons and benthos	4
1.4	Sampling of other aquatic organisms	2
2	**Soil & Air quality monitoring**	**6**
2.1	Soil sampling	2
2.2	Air sampling – particulate and gaseous sampling	2
2.3	Collection of weather data	2
3	**Ecology**	**9**
3.1	Biodiversity assessment : Quadrate method	3
3.2	Plotting large quadrates in Forests	2
3.3	Wild life Census	2
3.4	Collection of samples for plant taxonomy	2
4	**Environmental Geosciences**	**9**
4.1	Identification of rocks and minerals in the field	3
4.2	Measuring strike and dip of rock formations.	3
4.3	Data collection for Rose diagram (rocks)	2
4.4	Basic map reading.	1

	MAHATMA GANDHI UNIVERSITY
	Name of the course: SES MP E 09 **Nature Studies – Field skills and Techniques**

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

References

Marc Pansu, Jacques Gautheyrou, Hand book of soil analysis- Minerological, organic and inorganic methods, Springer, New York

Maria Csuros and CsabaCsuros, Environmental Sampling and Analysis for Metals, Lewis Publishers

Miroslav Radojevic and Vladimir N Bashkin, Practical Environmental Analysis, RSC Publishing

Conklin Alfred R. Introduction to Soil chemistry, analysis and Instrumentation, Jhonwiley&SonsNewyork

NEERI , Air quality monitoring, A course manual (Photostat), NEERI Nagpur

MamataTomar, Quality Assessment of Water and Waste Water, Lewis Publishers London

Abbasi S A, Water quality sampling and analysis, Discovery Publishing New Delhi

Christian Gary D, Analytical Chemistry, JhonWiley& Sons NewYork

MAHATMA GANDHI UNIVERSITY

Name of the course: SES MP E 10
Introduction to Remote Sensing, GNSSs and GIS

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

MAHATMA GANDHI UNIVERSITY

Name of the course: SES MP E 10
Introduction to Remote Sensing, GNSSs and GIS

Unit	Course Description	Hours
1	**Geodetical aspects, mapping concepts and surveying**	**10**
1.1	Earth System – Geodesy: Datum/Spheroids and coordinate systems, map projection - different projections and their characteristics	4
1.2	Features on the earth's surface: their basic properties – discrete vs continuous and geometries of representation	2
1.3	Cartography: Maps – their characteristics and elements, types - Basic surveying principles and techniques: EDMs and GNSSs; GNSSs – segments, various constellations, errors, differential correction and precise positioning Map reading and interpretation Global, national and state mapping agencies and their authorized reference maps – general & thematic	4
2	**Remote sensing: Introduction**	**10**
2.1	Remote sensing system – components and principles – platforms, sensors, medium, target, interactions and their characteristics including various resolutions, concept of DN value, radiance, reflectance, emission	3
2.2	Electromagnetic spectrum - energy interaction with atmosphere and earth surface, atmospheric windows, spectral properties of various objects on the earth's surface and the concept of spectral signature, active and passive remote sensing	4
2.3	Space borne earth observation: various orbits and their characteristics, operations, image acquisition and various data products Indian remote sensing programme& Other satellites and sensors like Landsat, SPOT, etc.	3

3	**Digital Image Processing**	**10**
3.1	Various image formats, loading and visualization – panchromatic and multispectral colour visualization – TCC and FCCs	3
3.2	Image restoration – geometric, radiometric – atmospheric errors and their correction Image enhancements – single band, multiband operations – layer stacking, ratioing and various indices, PCT, TCT, resolution merging/image fusion	4
3.3	Image interpretation – visual and digital; visual interpretation elements and key Digital image classification – unsupervised and supervised; accuracy assessment	3
4	**Geographical Information System (GIS): Basics**	**10**
4.1	Concepts, components and organisation of GIS Representing &modelling spatial features and processes - vector and raster structures, relationship between features – topology; raster data compressions and storage formats	4
4.2	Non-spatial/attribute Database Management Systems (DBMS), significance of DBMS, principles, data types, models – RDBMS, data storage, query and retrieval	3
4.3	Basic GIS functions: data inputting methods & various data sources, data management, data manipulation and geographic analysis and output presentation	3
5	**Global Navigational Satellite Systems: Basics**	**6**
5.1	Basic concepts of Global Navigational Satellite Systems (GNSSs): History and timeline, overview. Components of GNSSs (Space Segment, Control Segment, User Segment),GPSworking principle, -	3

5.2	GPS (Global positioning System), - GLONASS, Galileo ,BeiDou, NavIC, GPS signals (L1 and L2 Frequencies)/ Course-Acquisition (C/A) code Precision (P) code,	3
6	**Geographic analysis and modelling**	**8**
6.1	Exploration, query, vector spatial analysis &geoprocessing – extraction, proximity, overlay Network analysis – route, trace, closest facility, allocation	3
6.2	Raster based spatial modeling and analysis – density, distance, map algebra – arithmetic & weighted overlay: multi-criteria decision making	3
6.3	Surface modeling and analysis: DEM creation – input sources, interpolation; slope, aspect, volume, profile, hillshade, viewshed, visibility, contouring	2

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

References

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13. John Wainwright and Mark Mulligan (Eds). 2004. Environmental modeling - finding simplicity in complexity. John Wiley & Sons Ltd.
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23. Steven E. Franklin. 2001. Remote Sensing for Sustainable forest management. Lewis publishers.
24. Wise S. 2002. GIS Basics. Taylor Publications.
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School Name	School of Environmental Sciences						
Programme	M.Sc. Environment Science and Management						
Course Name	Analytical Techniques and Instrumentation						
Type of Course	Core						
Course Code	SES MP C 11						
Names of Academic Staff & Qualifications	Dr. C.T. Aravindakumar						
Course summary & Justification	The csourse will discuss on various classical and modern analytical techniques. After the program, the students will able to do the gravimetri, volumetric, and instrumental method of analysis.						
Semester		**2**	**Semester**			**2**	
Total Student Learning Time (SLT)	**Learning approach**		**Lecture**	**Tutorial**	**Practical**	**Others**	**Total hrs**
							60
Pre-requisite							

Unit	Course Description	Hours
1	**Introduction**	
1.1	Significant figures, Accuracy and precision	**2**
1.2	Types of errors- random and systematic errors, Standard deviation	**3**
2	**Gravimetric methods**	
2.1	Mechanism of formation of precipitates, Characteristics of ideal precipitate, Methods to improve filterability and minimizing adsorbed	**3**

	impurities	
2.2	Precipitation from homogeneous solutions, Organic and inorganic precipitating agents,	**3**
2.3	Application of gravimetric methods	**3**
3	**Volumetric methods**	
3.1	Molarity, Normality, Standard solutions, End point	**3**
3.2	Acid-base titrations – titration curves, theory of indicators	**2**
3.3	Complexometric titrations-EDTA titrations-applications	**3**
3.4	Iodometry, Iodimetry, Colorimetric titrations	**3**
4	**Spectrochemical methods**	
4.1	Electromagnetic spectrum, Interaction of light with matter/molecule	**3**
4.2	Fundamentals of molecular spectroscopy	**3**
4.3	Wavelength selectors: Filters and Monochromators, Radiation detectors and Transducers	**2**
4.4	Mass pectrometry	**3**
4.5	Atomic Absorption spectroscopy (AAS), Inductively coupled plasma mass spectrometry (ICP-MS) -principle and applications	**4**
4.6	Microwave, IR, Electronic, Raman, NMR and ESR spectroscopy-principle	**3**
4.7	SEM,TEM- instrumentation and applications	**2**
5	**Radiation detectors**	
5.1	Dosimetry, Geiger Muller Counter, Scintillation Counter	**4**
5.2	Electrochemical Methods: pH meter- Glass and reference electrodes, Conductivity met	**4**
6	**Chromatographic Techniques and environmental applications**	
6.1	Paper Chromatography, Thin Layer Chromatography, Column Chromatography, Ion Chromatography	**2**
6.2	Gas Chromatography(GC), GC-MS	**2**
6.3	Liquid Chromatography, High Performance Liquid Chromatography	**3**

	(HPLC), LC-MS, LC-MS/MS	

Teaching and Learning Approach	
Assessment Types	3. Continuous Internal Assessment (CIA) 3. Internal test 4. Review of Book /Article 5. Seminar Presentation 6. Field visit report 4. Semester End examination

References

1. APHA (1998), Standard Methods for the Examination of Water and Waste water, 20th edition, Washington DC
2. McBride, M.B. (1994), Environmental Chemistry of Soils, Oxford University Press, New York
3. Skoog, D.A. and Leary, J.J. (1992), Principles of Instrumental Analysis, 4thedition, Saunder's College Publishing, Fortworth
4. Suchla, G (Ed.) (1987) Vogel's Qualitative Inorganic Chemistry, ELBS.
5. Willard, H.H., Merrit, L.L., Deen, J.A. and Settle, F.A. (1986), Instrumental Methods of Analysis, (Indian Reprint), CBS Publishers and Distributors, New Delhi
6. Skoog, West, Holler Crouch, Fundamentals of Analytical Chemistry, 8th edition, Cengage LearningJ.Throck Watson, Introduction to Mass Spectrometry, 3rd edition, Lippincott-Raven publishers, Philadelphia, New York
7. Gary D. Christian. Analytical Chemistry, 5th edition, John Wiley and Son

MAHATMA GANDHI UNIVERSITY

Name of the Course : SES MP C 12
Environmental Biotechnology and waste management

School Name	School of Environmental Sciences						
Programme	M.Sc. Environment Science and Management M.Sc Environment Science and Disaster Management						
Course Name	Environmental Biotechnology and Waste Management						
Type of Course	Core						
Course Code	**SES MP C 12**						
Names of Academic Staff & Qualifications	Dr. E.V.Ramasamy ,M.Tech., Ph.D						
Course summary & Justification	**Course Summary:** Application of Biotechnological methods in controlling air, water and soil pollution. Understanding the blend of Ecology and Engineering in wastewater remediation and solid waste management. New concept of Ecological Sanitation (ECOSAN) is introduced in this course. **Justification :**A thorough understanding of waste management (Both Solid and Liquid) with biological methods and information gain on emerging knowledge domains like : Zero waste concept including Design for Environment – Industrial Ecology (IE), Life Cycle Assessment (LCA), Extended Producer Responsibility , Servicising, Ecological sanitation based closing the loop concept (circular economy).						
Semester		**2**	**Credit**			**3**	
Total Student Learning Time (SLT)	**Learning approach**		**Lecture**	**Tutorial**	**Practical**	**Others**	**Total hrs**
							54
Pre-requisite							

Unit	Course Description	Hours
1	**Cell Technology and Biotechnology**	**4**
1.1	Cell : Structure and function – Prokaryotes and Eukaryotes. Nucleic Acids, Central dogma - Protein synthesis, rDNA technology. Fermentation Technology.	2

1.2	Plant tissue culture techniques	1
1.3	Environmental Biotechnology: an overview.	1
2	**Biotechnological Methods in Pollution Control**	**16**
2.1	Air pollution control : Bio-desulphurisation of coal, Green belts.	6
2.2	Water pollution control : Aerobic and Anaerobic wastewater treatment Systems.	6
2.3	Bioremediation : Soil / land contaminated with oil spills, PCBs, PAHs; Bioremediation technology; Phytoremediation	2
2.4	Biosensors : Concept and principle ,Biosensors for environmental monitoring	2
3	**Emerging Trends in Environmental Biotechnology**	**10**
3.1	Agrobiotechnology : Plant genetic engineering – role of rDNA technique;transgenic plants - GM crops, Biopesticides and Biofertilizers	6
3.2	Ecological Engineering : Constructed / Artificial wetlands, Nutrient FilmTechnique (NFT).	2
3.3	Biodegradable plastics – PHBs and PHAs	2
4	**Solid Waste Management**	**16**
4.1	Municipal Solid Waste : Types, sources , properties and impacts	1
4.2	Techniques for treatment / processing : Concept of three ' R ' s, Thermal processes – incineration, Pyrolysis, RDF. Biological processes – Anaerobicdigestion, Composting and vermicomposting.	8
4.3	Disposal techniques : Landfills – design , operation and management.	4
4.4	Hazardous waste management.	2
4.5	Concept of Zero waste	1
5	**Ecological Sanitation**	**8**
5.1	Conventional sanitation : a linear flow system – its limitations	1
5.2	Eco San –Circular flow and closing the loop : concept, goals and advantages	2
5.3	Eco San for human night soil management : Dry Toilets, Composting Toilets UDDT,UDFT.	2
5.4	Grey water management	2
5.5	Eco San - Human Health and Food Security	1

. Teaching and Learning Approach	
Assessment Types	1. Continuous Internal Assessment (CIA) • Assignments • Seminar Presentation on selected topics • Quiz • Tutorials • Class tests 2. Semester End examination

References

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4. Davis, M.L. and Cornwell,D.A. 1991. Introduction to Environmental Engineering, McGraw Hill International Edition
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MAHATMA GANDHI UNIVERSITY

Name of the course : SES MP C 13
Biodiversity and Conservation Biology

School Name	School of Environmental Sciences					
Programme	M.Sc. Environment Science and Management M.Sc Environment Science and Disaster Management					
Course Name	Biodiversity and Conservation Biology					
Type of Course	Core					
Course Code	**SES MP C 13**					
Course Summary & Justification	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	2		**Credit**		3	
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Case based learning					60
Pre-requisite	As per the requirement of the course					

		Hrs
Unit 1 Biodiversity - An introduction		
1.1	The evolution of biodiversity	1
1.2	Theories and Concepts of Biodiversity	1

1.3	Origin of species/speciation	1
1.4	The distribution of biodiversity in macroscale	1
1.5	Species interactions and biodiversity	1
Unit 2 - Biodiversity		
2.1	Levels of Biodiversity	1
2.2	Geneticdiversity,speciesdiversity,Eco-systemdiversity, alpha, beta, gamma	1
2.3	Global and Regionalbiodiversity	1
2.4	ThreatstoBiological Diversity– HabitatDegradation,Fragmentation,Global Climate Change,overextraction,overabundance, alienandinvasivespecies,diseases, pollution	6
2.5	Endangered and Threatenedspecies,IUCN,Red DataBook	3
Unit 3 Biodiversity ConservationinPractice		
3.1	Global Conservationinitiatives–Biodiversity hotspots,ConservationinSouthand Southeast Asia,	2
3.2	National ConservationActionPlan,	2
3.3	Landscape-levelConservation	2
3.4	ConservationStrategies	2
3.5	Insituandexsituconservation	2
Unit 4 IntroductiontoConservationBiology		
4.1	History,Concepts andBackground	2
4.2	Biogeography of India	2

4.3	WesternGhats	2
4.4	Wild life biology	3
4.5	Restoration biology	3
Unit 5 NaturalHistory		
5.1	NaturalHistoryinIndia	2
5.2	AnimalBehaviour	4
5.3	GeneralEntomology,Ornithology,Mammalogy,Ichthyology,Herpetology	4
5.4	Basicunderstandingofcommonflora inSouthernWesternGhats	2
Unit 6 HumanEcology		
6.1	Environmental HistoryandConservationMovements	2
6.2	PeopleandNature:Ecosystemservices	2
6.3	IndigenouscommunitiesandEthnobiology	2
6.4	Human-wildlife Conflict	2
Unit 7 : Conservation – Legal and policy framework		
7.1	International treaties - Convention on Biological diversity, CITES, TRAFFIC	2
7.2	Legal aspects of conservation in India.	2
7.3	Biopiracy – causes and effects	2

	MAHATMA GANDHI UNIVERSITY
	Name of the course : SES MP C 13 **Biodiversity and Conservation Biology**

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

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5. Martin,G.J.1995.Ethnobotany-Amethodsmanual.Chapman &Hall.Madras.
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MAHATMA GANDHI UNIVERSITY

Name of the course : SES MP C 14
Lab Course II (Environmental Chemistry, Microbiology, Biotechnology, RS & GIS**)**

School Name	School of Environmental Sciences						
Programme	M.Sc. Environment Science and Management						
Course Name	Lab Course II (Environmental Chemistry, Microbiology, Biotechnology, RS & GIS)						
Type of Course	Core						
Course Code	**SES MP C 14**						
Names of Academic Staff & Qualifications	Dr. Mahesh Mohan; Dr. Sylas V.P.; Dr. E.V. Ramasamy; Dr. Harsha H.T., Dr. Abin Varghese						
Course summary & Justification	The course will enable students to understand various physico-chemical parameters determining water, air and soil quality and to carry out environmental sampling and analysis. It will also enable students to identify microbial pollution of water and soil environment. The students will able to identify and isolate microbes from the environment. The students will also get acquainted with the RS & GIS technique and become able to do map preparation and other applications of GIS.						
Semester		**2**	**Semester**			**2**	
Total Student Learning Time (SLT)	**Learning approach**		**Lecture**	**Tutorial**	**Practical**	**Others**	**Total hrs**
							60
Pre-requisite							

MAHATMA GANDHI UNIVERSITY

Name of the course : SES MP C 14
Lab Course II (Environmental Chemistry, Microbiology, Biotechnology, RS & GIS**)**

Unit	Course Description	
1	**Water quality**	
1.1	Analysis of COD, Sulphate, Sulphide, Potassium, Iron	**4**
1.2	Nutrient analysis (Nitrite, Nitrate, TN, Phosphate)	**4**
1.3	Total and dissolved metals in water	**2**
2	**Environmental microbiology**	
2.1	Preparation and 53haracterizat of bacteriological media – use of autoclave and hot air oven for sterilisation	**2**
2.2	Isolation and enumeration of microorganisms in environmental samples (soil and water)	**1**
2.3	Pure culture techniques – quadrant streaking, continuous streaking methods	**1**
2.4	Use of compound microscope	**1**
2.5	Staining techniques – Simple stain, Gram stain Endospore staining	**1**
2.6	Detection of bacterial motility – hanging drop method, use of semi solid agar	**1**
2.7	Basic biochemical test for characterization of bacteria – Oxidase test and catalase test and oxidation/ fermentation (O/F) test	**1**
2.8	Membrane filter technique to detect faecal coliforms in water and Escherichia coli Indole, Methyl Red (MR), Voges-Proskauer and Citrate (IMViC) tests for the 53haracterization of E. coli	**2**

3	**Soil/sediment quality**	
3.1	Available Nitrogen, Total Nitrogen, Available Phosphorous, Available potassium	**4**
3.2	Trace metals	**2**
4	**Air quality**	
4.1	Ambient Gaseous pollutant analysis – SO_x, NO_x, CO,	**4**
4.2	Ambient particulate monitoring – SPM, RPM	**3**
4.3	Online monitoring of ambient air quality	**1**
5	**RS and GIS**	
5.1	Understanding base map (Toposheet, Geology map, cadastral map etc.)	**2**
	Understanding various Software's in GIS (ArcGIS, QGIS),	**1**
5.2	Georeferencing base map	**2**
5.3	Creation of Spatial and Non spatial data(Geodatabase, Shapefiles, Attribute data)	**4**
5.4	Creating and editing of Point, Line and Polygon	**2**
5.5	Vector data analysis (Explore, Report generations, Geometry calculations, SQL (Arithmetic and Boolean Operators), Overlay analysis (Clip, Erase, Split, Union, Identity, Intersect)	**2**
5.6	Remote Sensing Open data web portals (Earth Explorer, Bhuvanetc) Understanding various Satellite Missions and Sensors Learn how to download data	**4**

5.7	Creation of Triangular Irregular Network (TIN)	**3**
5.8	Adding various bands of data to Image Processing Software, Understanding various resolution data, Dn values of Pixels	**3**
5.9	Layer Stacking	**2**
5.10	Preparation of Various Color Composites (True Color Composite, False Color Composite)	**1**

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

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MAHATMA GANDHI UNIVERSITY

Name of the course : SES MP E 15
Environmental Laws, Ethics, Education and Policy

School Name	School of Environmental Sciences						
Programme	M.Sc. Environment Science and Management						
Course Name	Environmental Laws, Ethics, Education and Policy						
Type of Course	Core						
Course Code	SES MP E 15						
Names of Academic Staff & Qualifications	Adv. Somanathan, Dr. Mahesh Mohan , MSc., PhD;						
Course summary & Justification	The course deals with the history of environmental laws and their evolution to modern environmental laws. The course discusses various international treaties and conventions conducted for environmental protection. It also describes various policies and laws in India for the protection of the environment. The course explains the principles of international laws. Environmental education, its history and present status in India are also described in this course.						
Semester		**2**	**Semester**			**2**	
Total Student Learning Time (SLT)	**Learning approach**		**Lecture**	**Tutorial**	**Practical**	**Others**	**Total hrs**
							40
Pre-requisite							

Unit	Course Description	Hours
1	**Introduction**	
1.1	History of Environmental Regulations	**1**
1.2	Emerging of NGOs like WWF	**2**
1.3	United Nations Conference on Human Environment (Stockholm	**2**

	Conference – 1972),	
1.4	Environmental treaties before 1990	**1**
1.5	International literature and report on human environment – The limits to growth, Our common future,	**2**
1.5	General principles and concepts of international Environmental law: Precautionary principle; Polluter pays principle; Sustainable development; Public trust doctrine. Overview of legislations and basic concepts	**2**
2	**Environmental Policy in India**	
2.1	Environmental Legislation Protection Laws in India – Ancient and Pre- Independence.	**2**
2.2	Environmental Legislation in Post – Independence Period	**2**
2.3	Constitutional and Legislative Provisions in India. • Fundamental principle; 42nd Amendment Act; Direct Principles • Fundamental Rights, • Environmental Legislations (General) Environmental Protection Act of 1986	**2**
2.4	Judicial Remedies and Procedures. • Tort Law, Public Nuisance , Public Interest Litigation, Freedom of information	**1**
3	**Laws Relating to control of Pollution and Environment in India**	
3.1	Water Act and Related Acts, Rules and Regulations	**1**

3.2	Air Act – Related Acts, Rules and Regulations	**2**
3.3	Noise and Land Pollution Rules and Regulations	**2**
3.4	Rules and Notification made under Environmental (Protect) Act 1986 – Rules of Hazardous Microorganisms. Bio–medical waste, Recycled Plastics, Ozone Depleting Substances, SolidWaste Management, etc.	**2**
3.6	Environmental Laws and regulations in Kerala - Mining law, laws related to wetlands and other ecosystems	**2**
3.7	Case studies – Bhopal gas tragedy	**1**
4	**Forest and Wild Life Protection Act and Rules.**	
4.1	Forest policies and Legislation in Pre – independence Period.	**1**
4.2	Wildlife and Biodiversity: IFA, 1927; WLPA, 1972; FCA, 1980; Biological Diversity Act, 2002; Forest Rights Act, 2006.	**2**
4.3	Strategies for conservation–Project Tiger, Elephant, Rhino etc.	**1**
5	**International Organisation, Conservations and Protocols**	
4.1	United Nations, GEMS, UNEP, GEF, WCN etc.	**1**
4.2	Conventions after 1990: Rio, Rio+10, Rio+20, Kyoto protocol etc.	**2**
6	**Information, Education and Communication**	
5.1	Environmental education/awareness, lifestyle changes and consumerism. Values and ethics	**1**
5.2	Environmental education in India, Information Networks – ENVIS Centers – INFOTERA etc.	**1**
5.3	Role of NGO's in the Implementation of Environmental Policies.	**2**
5.4	Communication and Management.	**1**

	MAHATMA GANDHI UNIVERSITY
	Name of the course : SES MP E 15 **Environmental Laws, Ethics, Education and Policy**

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

References

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MAHATMA GANDHI UNIVERSITY

Name of the course : SES MP E 16
Environmental Economics and Sustainable Development

School Name	School of Environmental Sciences						
Programme	M.Sc. Environment Science and Management						
Course Name	Environmental Economics and Sustainable Development						
Type of Course	Core						
Course Code	SES MP E 16						
Names of Academic Staff & Qualifications	P.Padma., M.A., M.Phil., M.Ed.,						
Course summary & Justification							
Semester		**2**	**Credit**			**3**	
Total Student Learning Time (SLT)	**Learning approach**		**Lecture**	**Tutorial**	**Practical**	**Others**	**Total hrs**
							40
Pre-requisite							

Unit	Course Description	Hours
1	**Integrating Environment and Economics**	
1.1	History: The evolution of economic and environmental thinking. Elementary economic principles applied in environmental economics - theory of consumption, production, prices, market (equilibrium and failure) Market, policy, and environmental degradation	2
1.2	Economy, Environment – Interface: Material Balance Principle Energy.	1
2	**Fundamental concepts and theories in Environmental Economics**	
2.1	Environmental economics – meaning, scope and limitations	1
2.2	Basic Theory of Environmental Economics.	2

2.3	Environmental quality as a public good and its efficient level	2
2.4	Economic efficiency, Property Rights, Market failure and externalities - taxes, permits externalities as public goods, internalizing externalities, Coase's Theorem and its Critique	2
2.5	Cost- Benefit Analysis (CBA) and its Applications	2
2.6	Welfare economics: Welfare aspects of Environmental Economics - Principle of maximum social welfare - Pareto Criterion	2
3	**Environmental and Natural Resources (energy and water) Accounting**	
3.1	Population and environment.	1
3.2	Global Issues – Climate Change , Resource Depletion, Waste management etc.,	1
3.3	Natural Resources Management: Brown, Green and Blue Economies	2
3.4	Carbon trading, Emissions trading and Clean Development Mechanisms	2
3.5	Circular Economy : A futuristic approach	2
3.6	Environmental Policies -	1
4	**Sustainability and Sustainable Development**	
4.1	From problems to crises- Depletion of resources and environmental degradation	1
4.2	Sustainable Development: Strategies and Policies.	2
4.3	Sustainable human development index, Sustainability pillars	2
4.4	Gandhian model of sustainable development	1
4.5	Sustainable development goals and achievements.	2
5	**Sustainable Consumption**	
5.1	Definition, importance, relevance for developing countries - Difference between Sustainable Consumption from Sustainable Development and Sustainable Production - key issues -UN Guidelines Sustainable Consumption	2

5.2	Sustainable production and Sustainable consumption	1
5.3	Sustainable consumption Tools	2
5.4	Sustainable living and values	1
6	**Education for Environment and Sustainable Development**	
6.1	Environmental education	1
6.2	Education for Sustainable Development	1
6.3	Education for sustainable consumption	1
6.4	Eco – School	1
6.5	Mini project on resource consumption and conservation	3

Teaching and Learning Approach	
Assessment Types	1. Continuous Internal Assessment (CIA) Internal test Group Presentations Seminar Presentation 2. Semester End examination

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MAHATMA GANDHI UNIVERSITY

Name of the course : SES MP E 17
Ecotoxicology

School Name	School of Environmental Sciences						
Programme	M.Sc. Environment Science and Management						
Course Name	Ecotoxicology						
Type of Course	Elective						
Course Code	SES MP E 17						
Names of Academic Staff & Qualifications	Dr. Mahesh Mohan, MSc., PhD						
Course summary & Justification	The course's major goal is to provide students with the knowledge and skills necessary to assess the destiny of pollutants in the environment and their impacts on various biological organisation levels. To that goal, the conceptual framework established throughout the ecotoxicology course will be expanded and applied.						
Semester		**2**	**Semester**			**2**	
Total Student Learning Time (SLT)	**Learning approach**		**Lecture**	**Tutorial**	**Practical**	**Others**	**Total hrs**
							40
Pre-requisite							

Unit	Course Description	Hours
1	**Toxicants and ecosystem**	
1.1	Toxicants – organic and inorganic	**1**
1.2	Toxicants – entry into the environment, cycles and residence time	**2**

1.3	Transboundary movement of pollutants- factors affecting	**1**
1.4	Global environmental pollutants	**2**
1.5	Routes of exposure to humans – food, occupation, environment	**3**
2	**Toxicants and their effects**	
2.1	Effects of toxicants on populations and communities	**2**
2.2	Toxicity of pesticides, metals, radioactive minerals, fluorides, chemical fertilizers and air pollutants – cellular and molecular level	**2**
2.3	Damage process and action of toxicants – exposure, uptake, transport, storage, mechanism of action in plants and mammals	**2**
2.4	Toxicants in the food chain- Accumulation and magnification Multilevel trophic interactions and non-trophic interactions	**1**
2.5	Acute and chronic effects	**1**
2.6	Occupational hazards and diseases	**2**
2.7	Toxicity of biohazards	**1**
3	**Toxicity testing and indicators**	
3.1	Principles of toxicity testing, Factors to be considered in toxicity testing	**2**
3.2	Methods of toxicity evaluation at cellular and molecular level by in vitro and in vivo methods	**1**
3.3	Ecotoxicological testing methods – single species testing, microcosms etc.	**2**
3.4	Bioindicators , lacustrine communities as indicators of ecosystem stress Biosensors– concept and approach Biomarkers- classification, relationship of biomarkers to adverse	**2**

	effects	
4	**Sanitation, Health and Hygiene**	
4.1	Sanitation and Health- introduction and Current situation	**2**
4.2	Water and sanitation related diseases, respiratory infections, under nutrition	**2**
4.3	Successful approaches to sanitation-strategies Role of health sector Global experience in improving sanitation and hygiene	**2**
4.4	Climate change and diseases Epidemiology and health ecology Epidemiological diseases due to pollution problems	**1**
	Health effects of cosmetics and drugs Health risk assessment of toxic chemicals Ecological risk assessment	**2**
5	**Food Security**	
5.1	Concept of food security, food systems and public health	**1**
5.2	Interrelation between diet, food production, the environment, population and resources	**1**
5.3	Toxicants in food	**2**

Teaching and Learning Approach	
Assessment Types	1. Continuous Internal Assessment (CIA) Internal test

	Review of Book /Article Seminar Presentation Field visit report 2. Semester End examination

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MAHATMA GANDHI UNIVERSITY

Name of the Course : SES MP E 18
Green Chemistry and Nano technology

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

Unit	Course Description	Hours
1	**Introduction to Green chemistry**	
1.1	Introduction and need for green chemistry	**3**
1.2	Principles of green chemistry	**3**
1.3	percentage atom utilization and percentage atom economy; rearrangement, addition, substitution and elimination reactions;	**4**

	examples of catalytic reactions	
2	**Green synthesis**	
2.1	Planning green synthesis; evaluation of rearrangement, addition, substitution, elimination and pericyclic reactions for green reactions;	4
2.2	Selection of solvents; selection of starting materials; use of protecting groups; use of catalyst and low energy reactions	3
3	**Alternate approach to solvent chemistry**	
3.1	solvent free reactions; microwave assisted synthesis; ionic liquids as an ecofriendly solvent;	3
3.2	supercritical fluid extraction as a cleaner technology	**2**
4	**Green technologies**	
4.1	catalytic reactions; alternate waste treatment technologies: Advanced Oxidation Technologies for waste water treatment ,Phycoremediation, Sustainable sanitation	**6**
5	**Introduction to nanotechnology**	**6**
5.1	Particle size, surface area and quantum dots ; synthesis and fabrication – nano scale metal oxides, Carbon nanotubes , nanocomposites., Green nanosynthesis- types , methods and advantages; nanotechnology as a tool for sustainability, health and safety.	
6	**Characterization and applications of nano particles**	**6**
6.1	Characterization of nano particles for structural and chemical nature. Environmental applications of nano materials –ground water remediation, water purification, absorbent, membrance process, nano sensors, detection of pesticides and trace metal ions, environmental monitoring, social implications of nanoscience and technology.	

Teaching and Learning Approach	
Assessment Types	A. Continuous Internal Assessment (CIA) • Assignments • Seminar Presentation on selected topics • Quiz • Class tests B. Semester End examination

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MAHATMA GANDHI UNIVERSITY

Name of the Course : SES MP E 19
Fundamentals of Management

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

MAHATMA GANDHI UNIVERSITY

Name of the Course : SES MP E 19
Fundamentals of Management

Unit	Course Description	Hours
1	Introduction to Management:	**1**
1.1	Nature and Scope, Functions, Managerial Roles,	**3**
1.2	Management levels, Managerial Skills, Challenges of Management;	**3**
1.3	Evolution of Management- Classical Approach, The Behavioral approach; The Quantitative approach; The Systems Approach; Contingency Approach, IT Approach.	**3**
2	Planning and Decision Making:	
2.1	Framework for Planning – Process and Types of Plans,	**3**
2.2	Management by Objectives; Decision making and Problem Solving - Programmed and Non Programmed Decisions	**2**
2.3	Steps in Problem Solving and Decision Making; Bounded Rationality and Influences on Decision Making;	**3**
	Group Problem Solving and Decision Making, Creativity and Innovation in Managerial Work.	**3**
3	**Organization and HRM:**	
3.1	Principles of Organization: Organizational Design & Structures;	**3**
3.2	Departmentalization, Delegation; Empowerment, Centralization, Decentralization, Recentralization;	**2**
3.3	Organizational Culture; Organizational Climate and Organizational Change.	**2**
3.4	Human Resource Management	**2**
4	**Leading and Motivation:**	
4.1	Leadership Styles; Behavioral Leadership, Situational Leadership,	**4**
4.2	Leadership Skills, Leader as Mentor and Coach, Leadership	**3**

	during adversity and Crisis;	
4.3	Team Motivation - Types of Motivation	**3**

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

References

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4. Stephen P. Robbins,2009 Fundamentals of Management, Pearson Education.

MAHATMA GANDHI UNIVERSITY

Name of the Course : SES MP E 20
Environmental Microbiology

School Name	School of Environmental Sciences						
Programme	M.Sc. Environment Science and Management						
Course Name	Environmental Microbiology						
Type of Course	Elective						
Course Code	SES MP E 20						
Names of Academic Staff & Qualifications	Dr. Harsha HT, Mrs. Anuthara R.						
Course summary & Justification	The goal of this course is to give students a basic understanding of environmental microbiology, including the functional diversity of microorganisms in the environment and how it affects human welfare and ecosystem health, microbial interactions with pollutants in the environment, and microbial pathogens' fate in the environment. Microbial habitats, identification of microorganisms and their activities in the environment, microbial biogeochemistry, bioremediation, and water quality are among the topics discussed.						
Semester		**2**	**Credit**			**2**	
Total Student Learning Time (SLT)	**Learning approach**		**Lecture**	**Tutorial**	**Practical**	**Others**	**Total hrs**
							40
Pre-requisite							

Unit	Course Description	Hours
1	**Microorganisms in the environment (12**Hrs)	
1.1	Introduction, scope and brief history	**2**
1.2	Microorganisms in the environment– bacteria, fungi, protists, algae and viruses - characteristic features and their role in the environment	**3**
1.3	Morphology and the basic structure of bacteria - plasma membrane, cell wall, flagella , pili, capsule, slime layer, glycolcalyx, nucleoid, ribosomes, cytoplasmic inclusions	**2**
1.4	Microbial habitat in air, water and soil	**3**
1.5	Basics of Gram staining	**2**
2	**Isolation and characterisation of bacteria from the environment (12 Hrs)**	
2.1	pour plate and streak plate method. Use of different media and	**3**

	culture techniques.	
2.2	Pure culture techniques – streak plate method – quadrant streak and continuous streak methods. Maintenance of bacteria on agar slants and long term preservation as glycerol stock.	**3**
2.3	Outline of microbial taxonomy – phenetic and phylogenetic classification. Bergey's manual of determinative bacteriology	**3**
2.4	PCR technique - Principles and applications	**3**
3	**Microorganisms and environmental processes (10 hrs)**	
3.1	Role of microorganisms in biogeochemical cycles with special reference to carbon, nitrogen, phosphorus and sulphur cycles	**3**
3.2	Microorganisms in extreme environments – Archaebacteria – Psychrophiles, Thermophiles, Halophiles, Barophiles, Methanogenes etc.	**2**
3.3	Soil microbial communities and their association with plants – bipartite and tripartite associations - rhizosphere microflora, mycorrhizae – ecto and endomycorrhizae – VAM – actinorrhizae	**3**
3.4	Role of microorgainsms in biological transformation of pollutants	**2**
4	**Microorganisms and disease (12 Hrs)**	
4.1	Water and air borne pathogens	**4**
4.2	Diseases caused by microorganisms and their symptoms – routes of infection and control measures.	**4**
4.3	Microbial indicators of water quality – coliforms, faecal coliforms, *Escherichia coli and* faecal streptococci.	**4**
5	**Applications of microorganisms in environment management (12 hrs)**	
5.1	Waste water treatment	**4**
5.2	Application of genetically engineered organisms in the clean-up of the environment	**3**
5.3	Role of microorganisms in bioremediation	**3**
5.4	Pollutant-microbe interactions – metal-microbe interactions	**2**

Teaching and Learning Approach	
Assessment Types	A. Continuous Internal Assessment (CIA) 1. Internal test 2. Review of Book /Article

	3. Seminar Presentation 4. Field visit report B. Semester End examination

References

1. Claus, W.G. 1989. Understanding microbes: A Laboratory Text book for Microbiology. W. H. Freeman and Co., New York.
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MAHATMA GANDHI UNIVERSITY

Name of course : SES MP C 21
Environment Management

School Name	School of Environmental Sciences					
Programme	M.Sc.					
Course Name	Environment Management					
Type of Course	Core					
Course Code	SES MP C 21					
Course Summary & Justification	This course allows the students to learn the fundamentals theories and concepts of Environment Management.					
Semester	2		**Credit**		3	
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Case based learning					**60**
Pre-requisite	As per the requirement of the course					
Others- Case studies , Library, seminar and assignment preparations, test, research article/ case reports discussion etc.						

		Hrs
Unit 1: Introduction		
1.1	Basic Principles of Environment Management	2
1.2	Environment management – tools and techniques	2
1.3	Environment Management Systems (EMS)	2
1.4	Introduction to environmental quality models- input and output models, linear programming models of environmental quality management	2

1.5	Natural resources and their management	4
Unit 2: Environment Management Systems (EMS)		
2.1	International standards for Environment Management	4
2.2	ISO 14000 Family Standards	4
2.3	Other Environment Standards -ISO 9001, ISO 14001, ISO 45001, ISO 50001, ISO 20121 etc.	6
2.3	EMS in industries	2
Unit 3: Environmental Planning and Management (EPM)		
3.1	Principles of EPM	2
3.2	Concepts and scope of environmental planning	2
3.3	Ecological aspects of EPM	2
3.4	Steps in Environmental planning	1
3.5	Identification and formulation of strategies of EPM	1
3.6	Environmental analysis and EPM	1
3.7	Physical planning in relation to environmental and land use classification : EPM for Town and urban lands, Rural and agricultural lands, Waste lands, Lands reclaimed, Wetlands, Mining areas, Industrial areas, Transportation and urban planning	3
Unit 4: EPM for Environmental Hazards		
4.1	Environmental hazards and EPM	2
4.2	Types of environmental hazards- Food, drought, landslides, earthquakes, cyclones etc.	3
4.3	Significance and characteristics of hazards in environmental planning and development	2
4.4	Opportunities and regional planning for hazard management	2

Unit 5: Restoration of Ecosystems		
5.1	Ecorestoration- definition & history & significance	3
5.2	Degraded ecosystems – reasons – natural and anthropogenic	3
5.3	Restoration types – active and passive	4
5.4	Restoration process – pre-analysis, process and past monitoring	10
5.5	Global and regional initiatives	6

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

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1. Abbasi,S.A. (2001) Water resources projects and their environmental impacts. Discovery publishing house, Newdelhi.
2. Gangstad, I. (1990). Natural Resource management of water and land. Van Norstrand Reinhold, Newyork.
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MAHATMA GANDHI UNIVERSITY

Name of the course : SES MP C 22
Environmental Engineering

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

Unit	Course Description	Hours
1	**Introduction**	**4**
1.1	Environmental Engineering and Environmental Systems: Water resource management; air resource management	2
1.2	Solid waste management systems	1
1.3	Mass-balance approach to problem solving.	1

2	**Water Resource Management: Water and Wastewater Treatment**	**16**
2.1	Water quality studies: Sampling technique, Sampling devices, Sample preservation, Physical – Chemical and biological examination of water , Water quality standards	2
2.2	Water treatment - Filter plants :Mixing and flocculation, Coagulation, Jar test; Softening – lime soda and ion exchange process ; Filtration – slow, rapid and high – rate sand filters; Disinfection – Chlorination, Ozonation and UV application	6
2.3	Wastewater treatment : Municipal sewage treatment -Basic treatment processes and flow- sheets, Waste flow rates and their assessment; Unit operations of pre-treatment and primary treatment - Bar racks, grit chambers, communitors, equalization andsedimentation, Design concepts. Secondary treatment : Biological unit processes - Nature and kinetics of biological growth; Aerobic activated sludge process and its various modification; Oxidation ponds ; Attached growth systems – trickling filters, Rotating biological contactors (RBCs). Anaerobic wastewater treatment systems : Evolution of high – rate anaerobic reactors – CSTRs ; Up flow anaerobic filters (UAFs); UASBs, Expanded / Fluidised bed reactors. Chemical unit process :Precipitation, Coagulation , Disinfection. Tertiary / Advanced treatment system :Filtration ; Adsorption ; Nitrogen and phosphorous removal ; Biological nutrient removal (BNR) system. Land treatment – Slow rate, overland flow, rapid infiltration	8
3	**Air Resource Management: Air quality studies**	**8**
3.1	Air quality standards :Micro and macro air pollution ; Indoor air	2

	pollution ; Acid rain ; Ozone depletion ; Greenhouse effect	
3.2	Air pollution meteorology : The atmospheric engine ; Turbulence, stability, laps rate, plume behavior, terrain effects ; Factors affecting dispersion of air pollutants ; Dispersion modeling – Gaussian dispersion model	6
4	**Air Resource Management: Air Pollution Control**	**8**
4.1	Control of particulate matter :Gravitational ; Centrifugal; Electrostatic, fabric and wet collectors	2
4.2	Control of gaseous contaminants :Adsorption ; Absorption; Condensation ; Combustion	4
4.3	Automobile emission control	2
5	**Solid Waste Management: Municipal Solid Waste**	**12**
5.1	Types, sources and properties	1
5.2	Techniques for treatment / processing of solid waste : Recovery, reclamation, recycle and reuse of resources	6
5.3	Disposal methods for the solid waste residues : Incineration ; Sanitary land fills	3
5.4	Hazardous waste management	2
6	**Noise Pollution and Risk Assessment**	**6**
6.1	Noise pollution	
6.2	Noise levels, measurements and noise limits	1
6.3	Noise attenuation and control measures	1
6.4	Risk assessment and disaster management for industries : Case histories of major chemical disasters; Basic components of hazard control system; Technique of risk assessment – PHA, HAZOP, MAXCRED; Emergency control and disaster plan.	4

Teaching and Learning Approach	
Assessment Types	1. Continuous Internal Assessment (CIA) • Assignments • Seminar Presentation on selected topics • Quiz • Tutorials • Class tests 2. Semester End examination

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1. Abbasi, S.A. 1998. Environmental Pollution and its Control ,Cogent International , Pondicherry.
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MAHATMA GANDHI UNIVERSITY

Name of the course : SES MP C 23
Environmental Impact Assessment

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

MAHATMA GANDHI UNIVERSITY

Name of the course : SES MP C 23
Environmental Impact Assessment

Unit	Course Description	Hours
1	**Development projects and sustainability**	
1.1	Developmental Projects – types and proponents	**1**
1.2	Global changes and concept of Sustainability	**3**
1.3	Factors affecting sustainability	**1**
1.4	Efforts in achieving sustainability	**3**
1.5	Environment Management Techniques for Sustainable Development	**2**
2	**Environmental Impact Assessment**	
2.1	Definition, aim, history, principles and concepts and scope	**2**
2.2	EIA steps	**3**
2.3	Types of EIA	**2**
2.4	Public participation in EIA- significance	**2**
2.5	EIA – history and notifications in India	**2**
2.6	EIA in India – organizational structure	**2**
3	**Environmental Impacts**	
3.1	Positive and negative impacts Primary and Secondary impacts Impact on physical, social and biotic environments	**3**
3.2	Baseline evaluation	**2**
3.3	Alternatives and mitigation measures in EIA	**2**

3.4	Terms of reference	**2**
4	**Environmental Impact Assessment methods**	
4.1	EIA Methods and their functions	**2**
4.2	Adhoc method, Checklist Method, Sectoral guidelines, Systematic sequential approach, Simulation modelling workshops, Spatial analysis methods, Rapid assessment techniques	**3**
4.3	Interaction Matrices- Network and Overlays Approach, Moore Impact matrix	**3**
5	**EIA for different environmental programmes**	
5.1	Industries Urban development Mining	**3**
5.2	Energy projects : Hydel , Thermal, Nuclear, Oil and gas, Solar, Wind	**3**
5.3	EIA case studies	**2**
6	**Environment Audit**	
6.1	Introduction to environment audit-types; Environment auditor-auditing skills	**1**
6.2	Environment audit procedure – pre audit, site visit and post audit	**3**
6.3	Environmental auditing standards	
7	**Life Cycle Assessment (LCA) and EMS**	
7.1	LCA – introduction , basics, objectives Life cycle stages, LCA components	**3**

	Global and regional impact categories LCA applications – case studies LCA and standards	
7.2	Environment Management System (EMS)- introduction, structure, Procedure	**3**
7.3	LCA and EMS - Case studies	**2**

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

References

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MAHATMA GANDHI UNIVERSITY

Name of the course : SES MP C 24
Resource Mnagement

School Name	School of Environmental Sciences					
Programme	M.Sc.					
Course Name	Resourse Management					
Type of Course	Core					
Course Code	SES MP C 24					
Course Summary & Justification	This course allows the students to learn the fundamentals theories and concepts of Environment Management.					
Semester	2		**Credit**		3	
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Case based learning					60
Pre-requisite	As per the requirement of the course					
Others- Case studies , Library, seminar and assignment preparations, test, research article/ case reports discussion etc.						

		Hrs
Unit 1 Natural resources		
1.1	Classification on the basis of recovery rate - Renewable and Non-renewable resources	1
1.2	origin-biotic and biotic resources	1
1.3	stages of development – potential, actual, reserve & stock	2

1.4	National international status of non-renewable resources	2
1.5	Status of extraction of natural resources- global and regional	2
Unit 2: Ecosystem management		
2.1	Forest and Grassland management	6
2.2	Wetland Management	2
2.3	Management of Coastal and marine ecosystems	4
2.4	People's participation in ecosystem management	3
Unit 3: Water resource management		
3.1	Global Water Budget, global water availability, depletion of water resources , Interrelation of water resources with other natural resources and the environment	2
3.2	Dams and water resources	2
3.3	Basic Techniques for Water Analyses – Quality and Quantity	4
3.4	Watershed management	4
3.5	Irrigation water management	2
3.6	Integrated Water Resources Management (IWRM)	2
3.7	Concept of sustainable water resources development	2
3.8	Global Efforts - water resource management, Local water organisations; World water organisations; UN, GWP, WWC, etc	2
Unit 4: Physical Resources		
4.1	Soil and mineral resources- status and significance, problems facing	2

4.2	Soil quality management – engineering and ecological solutions	4
4.3	Control of soil erosion	3
4.4	Soil Management in Kerala	2
4.5	Radioactive minerals and their management	2
4.6	Metals and other minerals – management strategies	2
Unit 5: Biological Resources		
5.1	Forest resource management – NTFPs, biodiversity, medicinal plants	5
5.2	Integrated management of wild life population	3
5.3	Sustainable Management of biological resources of Kerala	2

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Authentic learning, case-based learning, collaborative learning, seminar, group activities.
Assessment Types	**Mode of Assessment** 7. Continuous Internal Assessment (CIA) 8. Seminar Presentation – 9. Assignments C. Semester End examination

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1. Abbasi,S.A. (2001) Water resources projects and their environmental impacts. Discovery publishing house, Newdelhi.
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MAHATMA GANDHI UNIVERSITY

Name of the course : SES MP C 25
Lab Course III

School Name	School of Environmental Sciences						
Programme	M.Sc. Environment Science and Management						
Course Name	Lab Course III (RS & GIS and Instrumental analysis)						
Type of Course	Core						
Course Code	SES MP C 25						
Names of Academic Staff & Qualifications	Dr. Mahesh Mohan; Dr. Baiju K.R., Dr. Sylas V.P., Dr. Abin Varghese						
Course summary & Justification	The course will enable students to understandthe instrumental analysis. The students will get hands on training on the sophisticated chromatographic and spectrometric equipment. The students will also get acquainted with the RS & GIS technique and become able do the Satellite processing and environmental application of GIS.						
Semester		**2**	**Semester**			**2**	
Total Student Learning Time (SLT)	**Learning approach**		**Lecture**	**Tutorial**	**Practical**	**Others**	**Total hrs**
							60
Pre-requisite							

MAHATMA GANDHI UNIVERSITY

Name of the course : SES MP C 25
Lab Course III

Unit	Course Description	Hours
1	**Spectroscopy**	
1.1	Spectrophotometer- UV, Vis, FTIR	**3**
1.2	ICP-MS	**3**
1.3	Mercury analyser – CVAAS, Direct Mercury Analyser, CVAFS	**3**
2	**Chromatography**	
2.1	LC	**3**
2.2	IC	**3**
2.3	LC-MS, LC-QToF	**3**
2.4	GC-TCD,ECD,FID	**3**
2.5	GC-MS	**3**
3	**Other equipment &Online monitoring instruments**	
3.1	TOC	**2**
3.2	Ambient Air Quality Monitoring System	**2**
3.3	Portable Water Quality Analyser	**2**
3.4	Portable Green House Gas analyser	**3**
4	**GIS**	
4.1	Creation of Digital Elevation Model, Understanding various freely available global DEMs	**2**
4.2	Raster Analysis in GIS (3D analysis tools- Line of sight, Line/	**2**

	Area Elevation profile)	
4.3	Generation of Slope, Aspect, Hillshade, Viewshed, Curvuture	**2**
4.4	Reclassification and Ranking	**2**
4.5	Raster Calculator	**1**
4.6	Weighted Overlay analysis	**3**
4.7	Raster Interpolations (IDW, Kriging)	**1**
4.8	Weighted Overlay	**1**
	RS& Image processing	
5.1	Understanding Geometric and Radiometric Errors	**1**
5.2	Geometric and Radiometric Corrections	**2**
5.3	Subseting the Image	**2**
5.4	Visual Interpretation of satellite image	**3**
5.4	Digital Image Classification (Supervised/ Unsupervised)	**3**
5.5	Image Enhancement Techniques (EVI, NDVI)	**2**

Teaching and Learning Approach	
Assessment Types	1. Continuous Internal Assessment (CIA) Internal test Review of Book /Article Seminar Presentation Field visit report 3. Semester End examination

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1. Abbasi S A, Water quality sampling and analysis, Discovery Publishing New Delhi.
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MAHATMA GANDHI UNIVERSITY

Name of the course : SES MP E 27
Climate Change and Governance

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

Unit	Course Description	Hours
1	**Basic definitions**	
1.1	Climate and weather; climate change;greenhouse gases; radiative forcing; warming potential	**2**
1.2	climate modelling; global and regional circulation models; IPCC modelling scenarios.	2

2	**Observed and projected changes in the climate system**	
2.1	Land surface temperature; ocean surface temperature; precipitation;cryosphere;sea level	**2**
2.2	Greenhouse gas (GHG) concentrations (CO_2 and Non CO_2 gases);and extreme climatic events.	2
3	**Drivers of climate change**	
3.1	Natural and anthropogenic radiative forcing; solar irradiance; aerosols, water vapour and clouds; volcanic eruption	**2**
3.2	GHG emissions from energy, industries, and transport; and gross and net emissions from agriculture, forestry and other land use.	2
4	**Impacts of climate change**	
4.1	Physical systems (Glaciers, snow, iceand/or permafrost;Rivers, lakes, floodsand/or drought; Coastal erosion and/or sea level effects)	**2**
4.2	Biological systems (Terrestrial ecosystems; aquatic ecosystems); Human and managed systems (Food production; Livelihoods, healthand/or economics)	2
5	**Greenhouse gas inventorying**	
5.1	IPCC guidelines on national greenhouse gas inventorying; general guidance and reporting; guidance specific to energy	**2**
5.2	Industrial processes and product use (IPPU), agriculture, forestry and other land use (AFOLU), and waste; activity data	**2**
5.3	Emission factors; key categories; tiered approach; stock-difference and gain-loss methods; principles of reporting; measurement, reporting and verification (MRV) system.	2

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

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Teaching and Learning Approach	
Assessment Types	4. Continuous Internal Assessment (CIA) • Assignments • Seminar Presentation on selected topics • Quiz • Class tests 5. Semester End examination

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