



SWAMI VIVEKANAND
SUBHARTI
UNIVERSITY
Meerut
UGC Approved
Where Education is a Passion ...



Ordinance No. :- V-141-B-11

(Approved in Academic Council meeting held on 11.03.2026
Proposed to be ratified in forthcoming executive council)

Evaluation Scheme and Syllabus

of

M.Sc. Environmental Science

TWO – YEAR POST GRADUATE

PROGRAM

(AS PER NEP-2020)

Keral Verma Subharti College of Science

Swami Vivekanand

SUBHARTI UNIVERSITY

Meerut

(Effective from session 2025-26)

K. V. Subharti College of Science
S V Subharti University
NH-58 Bypass Road, Meerut

PROGRAM OBJECTIVES

1: Build Strong Foundations in Environmental Systems

Develop an advanced understanding of Earth systems, ecological processes, environmental chemistry, geosciences, and anthropogenic impacts.

2: Develop Research and Analytical Competence

Equip students with skills in scientific inquiry, environmental monitoring, laboratory techniques, data analysis, modelling, RS-GIS, and EIA methodologies.

3: Prepare Industry-Ready Environmental Professionals

Enable learners to work in environmental consulting, pollution control boards, industries, NGOs, government agencies, and research organizations with professional competence.

4: Promote Sustainable Resource Management

Cultivate the ability to assess and manage natural resources, environmental pollution, climate risks, biodiversity conservation, and sustainable development strategies.

5: Strengthen Ethical and Social Responsibility

Instill environmental ethics, policy awareness, sustainability thinking, and responsible decision-making for societal and ecological well-being.

6: Encourage Innovation and Problem-Solving

Foster creativity and practical skills to design eco-technologies, bioremediation approaches, waste-management solutions, and climate-adaptation strategies.



PROGRAM OUTCOMES

PO1: Advanced Environmental Knowledge

Demonstrate comprehensive understanding of environmental processes, pollution science, ecology, biodiversity, geosciences, toxicology, and climate science.

PO2: Analytical and Scientific Skills

Apply advanced laboratory, field, statistical, and modelling tools (RS-GIS, EIA, LCA, hydrological assessments, air & water quality monitoring) to solve environmental problems.

PO3: Research Competence

Design, conduct, and interpret independent research, including problem identification, hypothesis formulation, experimental design, data analysis, and scientific writing.

PO4: Environmental Monitoring & Assessment

Perform environmental audits, risk assessments, EIA studies, pollution monitoring, and environmental data interpretation for decision-making.

PO5: Technological Proficiency

Use modern tools and environmental technologies—bioreactors, microbial biotechnology, eco-engineering, remote sensing, simulation, and modelling tools.

PO6: Sustainable Resource Management

Develop scientifically justified strategies for conservation of biodiversity, soil, water, forests, wetlands, and energy resources using sustainable and integrated approaches.

PO7: Policy, Governance, and Ethics

Understand environmental laws, regulatory frameworks, climate policies, and ethical responsibilities relevant to environmental decision-making.

PO8: Problem-Solving and Innovation

Identify environmental challenges and propose innovative, feasible, and sustainable solutions for pollution control, waste management, and ecosystem restoration.

PO9: Communication & Professional Skills

Present environmental reports, scientific findings, and technical documentation clearly to scientific, governmental, and community stakeholders.



CREDIT DISTRIBUTION TABLE

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT							
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE							
Department of Life Science							
M.Sc. Environmental Science (Session 2025-26 onwards)							
		I	II	Internship after II Sem	III	IV	Total
1	Core Course	16	16	4	8	4	44
2	Elective (DEC)	-	-		8	8	16
3	PC/Dissertation/Project Work	8	8		8	12	36
4	Seminar/VAC/OEC/EEC/CHM	2 (Seminar)	2 (CHM)		2 (OEC)	2 (EEC)	8
	Total	26	26		26	26	108

K. V. Subharti College of Science
S V Subharti University
NH-58 Bypass Road, Meerut

EVALUATION SCHEME

I YEAR

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT													
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE													
Department of Life Science													
Course Name - M.Sc Environmental Science													
SEM:I													
Batch:2025-26			SEM:I										
S. No.	Course Type	Course Code	Course Name	Teaching Load			Credits	Attendance (5)	Internal Assessment		External Assessment	Total	Remark
				L	T	P			quiz/PPT/Assignment (10)	Mid Sem Test (15)			
THEORY and PRACTICAL SUBJECTS													
1	Core Course 1	MSES-101	Introduction to Environmental Sciences	4	0	0	4	5	10	15	70	100	
2	Core Course 2	MSES-102	Social perspectives on environment	4	0	0	4	5	10	15	70	100	
3	Core Course 3	MSES-103	Environment, development & sustainability	4	0	0	4	5	10	15	70	100	
4	Core Course 4	MSES-104	Methodologies for environmental studies	4	0	0	4	5	10	15	70	100	
5	Practical I (Based on CC 1 & 3)	MSES-105P	Introduction to Environmental Sciences and cell biology, Environment, development & sustainability Lab	0	0	8	4	5	10	15	70	100	
6	Practical II (Based on CC 2 & 4)	MSES-106P	Social perspectives on environment, Methodologies for environmental studies Lab	0	0	8	4	5	10	15	70	100	
7	Seminar I	MSES-107		0	0	4	2	5	10	0	35	50	
TOTAL CREDITS / ASSESSMENT							26	35	70	90	455	650	

SEM:II													
Batch:2025-26			SEM:II										
S. No.	Course Type	Course Code	Course Name	Teaching Load			Credits	Attendance (5)	Internal Assessment		External Assessment	Total	Remark
				L	T	P			quiz/PPT/Assignment (10)	Mid Sem Test (15)			
THEORY and PRACTICAL SUBJECTS													
1	Core Course 5	MSE S-201	Environmental impact and risk assessment	4	0	0	4	5	10	15	70	100	
2	Core Course 6	MSE S-202	Pollution and health	4	0	0	4	5	10	15	70	100	
3	Core Course 7	MSE S-203	Urban ecosystems	4		0	4	5	10	15	70	100	
4	Core Course 8	MSE S-204	Natural resources: conservation and management	4	0	0	4	5	10	15	70	100	
5	Practical III (Based on CC 5 & 6)	MSE S-205P	Environmental impact ,Pollution and health Lab	0	0	8	4	5	10	15	70	100	
6	Practical IV (Based on CC 7 & 8)	MSE S-206p	Urban ecosystems and conservation and management lab	0	0	8	4	5	10	15	70	100	
7	CHM 1	MSE S-207		2	0	0	2	5	10	0	35	50	
TOTAL CREDITS / ASSESSMENT							26	35	70	90	455	650	

DETAILED SYLLABUS

Programme/Class: Certificate	Year: First	Semester: First
CourseCode: MSES-101	CourseTitle: Introduction to Environmental Sciences	
<p>Courseoutcomes:</p> <p>CO1: Understand the fundamental concepts, scope, and importance of Environmental Science, and recognize the interdisciplinary nature of the subject.</p> <p>CO2: Identify and explain major environmental issues such as pollution, climate change, biodiversity loss, and resource depletion, and their impacts on ecosystems and human life.</p> <p>CO3: Describe the structure and function of ecological systems, including ecosystems, food chains, and biogeochemical cycles.</p> <p>CO4: Analyze human-environment interactions, population dynamics, and the role of technology and development in environmental degradation and conservation.</p> <p>CO5: Evaluate environmental policies, sustainable development goals (SDGs), and legal frameworks in India and globally that address environmental protection.</p>		

Credits: 4	Core: Compulsory
Max.Marks: 30+70=100	Min.Passing Marks: 40

Unit	Topic	No. of Lectures (60)
I	Introduction to the Environment. Acquisition, transformation and utilization of energy: the geochemical, biogeochemical and hydrological cycles. Concept of ecosystem. Atmosphere: structure and composition. Air pollutants and their emission sources. Aerosols and Smogs. Air quality standards. Tropospheric ozone. Air pollution in Indian cities.	14
II	Water: quantity and quality. Parameters and standards; Demands. Rain water chemistry. Surface and subsurface waters in India. Environmental hotspots related to water in India.	12
III	Soil and Land use: climate and soil profile, petrography and mineral matters in soil. Soil classification. Soil distribution in India. Land use in India. Impact of soil loss and land cover on biogeochemical cycle.	10
IV	Biodiversity. Problems and issues in biodiversity and forestry. Conservation and utilization of biodiversity. Global warming and climate change. Recent records of climate change. Impact of climate change on Indian environment. Measures to cope with climate change.	14
V	Biodiversity. Problems and issues in biodiversity and forestry. Conservation and utilization of biodiversity. Global warming and climate change. Recent records of climate change. Impact of climate change on Indian environment. Measures to cope with climate change.	10

Suggested Books:

Suggested Readings:

1. Anjaneyulu. Y, 2004, Introduction to Environmental Science.
2. B. S. Publications. D. Daniel Chiras, 2001, Environmental Science, 6 th Ed., Jones and Bartlett Publishers.
3. Mukherji Shormila, 2004, Fragile environment, Manak Publication Pvt. Ltd.

4. Subramanian. V, 2002, A text book in Environmental Science, Narosa Publishing House, New Delhi.
5. Wright. R.T, and Nebel. B. J, 2004, Environmental Science, 8 th Ed. Prentice Hall India Ltd.

Programme/Class:Certificate	Year:First	Semester:First
CourseCode:MSES-102	CourseTitle:SOCIAL PERSPECTIVES ON ENVIRONMENT	

Courseoutcomes:

CO1: Understand the interrelationship between society and the environment from historical, cultural, and sociological perspectives.

CO2: Analyze how social structures, institutions, and cultural practices influence environmental use, management, and degradation.

CO3: Examine environmental justice, equity, and the differential impacts of environmental issues on various social groups (e.g., caste, class, gender, indigenous communities).

CO4: Interpret key environmental theories and movements from social science perspectives, including ecofeminism, deep ecology, and sustainable development.

CO5: Assess the role of community participation, traditional knowledge, and social movements in environmental conservation and policy-making.

Credits: 4

Core: Compulsory

Max.Marks:30+70=100

Min.Passing Marks: 40

Unit	Topic	No. of Lectures (60)
I	Introduction to environmental thought. Traditions of thinking about environment from deep ecology to modernization, reflections on industrial societies and risk. Indian and global thinkers are discussed.	12
II	Early issues in Indian environmentalism: land, forest and water. Looks at historical developments in key areas such as land management, forestry and water management in colonial India, both from the perspective of the state and of communities. Differences across various regions in India are explored.	12
III	Environmental politics in contemporary India. Introduces a range of policy initiatives and popular struggles around contemporary environmental issues such as, forests, wildlife, water, traditional knowledge and environmental resources and pollution. Issues in global environmentalism. Explores significant global environmental issues such as acid rain, climate change etc., examining both the nature of the issues and instruments of international environmental negotiations.	12
IV	Urbanization and environment. The process of urbanization is explored with respect of consumption of resources; environmental consequences of urban transformation, waste disposal and pollution. Environment, technology and society. Examines the interface between specific technologies, including	12

	electrification, transport technologies, energy generation etc. and rural/urban environments.	
V	Population and resources. Explores the historically evolving relationship between population pressures, resource consumption and sustainability. Tragedy of commons Indian and global debates are introduced. Risk and ecological modernization. The nature of environmental risk that emerges in the wake of modernity and the responses to the same in select national contexts are introduced.	12
<p>1. Grove Richard, 1997, Ecology, climate and empire. Colonialism and Global Environmental History, 1400-1900. Cambridge, White House.</p> <p>2. Guha Ramchandra, 1989, Ecological change and peasant resistance in the Himalaya. Unquiet Woods. Oxford University Press, Delhi.</p> <p>3. Harrison Mark, 1999, Climates and Constitutions. Health, Race, Environment and British imperialism in India, 1600-1850.</p> <p>4. O.U.P., Delhi. K.B. Chokkan, Pandya, H and Raghunathan, H (Eds), 2004, Understanding Environment. Sagar publication India Pvt. Ltd., New Delhi, London</p>		

Programme/Class: Certificate	Year: First	Semester: First
Subject: Environmental Science		
Course Code: MSES-103	Course Title: ENVIRONMENT, DEVELOPMENT AND SUSTAINABILITY	

<p>Course outcomes:</p> <p>CO1: Understand the interconnections between environment, economic development, and sustainability from local to global scales.</p> <p>CO2: Analyze various models and paradigms of development (e.g., growth-oriented, sustainable, inclusive) and their environmental implications.</p> <p>CO3: Examine major environmental challenges such as climate change, biodiversity loss, and natural resource depletion in the context of development practices.</p> <p>CO4: Evaluate the principles of sustainable development, including the Sustainable Development Goals (SDGs), and their relevance in policy and planning.</p> <p>CO5: Assess the role of institutions, governance, and policy frameworks (both national and international) in achieving environmental sustainability.</p>
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Credits: 4	Core: Compulsory	
Max.Marks: 30+70=100	Min. Passing Marks: 40	
Unit	Topic	No. of Lectures (60)

I	Concept of sustainability science, sustainable development and its different constituents. Drivers of ecological changes and its implication for society.	12
II	Principles of ecological economics – scope and usefulness. Prey-Predator and supply-demand cycles.	12
III	Valuation of ecosystem services and impact of intervention (malign and benign). Sustainability of society, resources and framework.	12
IV	Natural resources accounting – concepts, methods and empirical evidences. Environment and trade.	12
V	Cost of environment, pollution, life cycle assessment. Impact of development on biodiversity. Development indicators and human health.	12

Suggested Readings:

1. Baumol and Oates, 1988, Theory of Environmental Policies, Cambridge University Press, Cambridge, UK.
2. Freeman A.M., 2001, Measures of value and Resources: Resources for the future, Washington DC.
3. Freeman. A.M., 2003, Millennium Ecosystem Assessment: Conceptual framework. Island Press.
4. Shogren, White and Hanley, 2001, Introduction to Environmental Economics, Oxford University Press, New York.
5. Tietenberg. T, 2003, Environmental and Natural Resource Economics. Pearson Education, New York.

Programme/Class: Certificate	Year: First	Semester: First
Course Code: MSES-104	Course Title: METHODOLOGIES FOR ENVIRONMENTAL STUDIES	

Course outcomes:

CO1: Understand key research methodologies and approaches used in environmental studies, including qualitative, quantitative, and mixed methods.

CO2: Identify appropriate research design, sampling techniques, and data collection tools (e.g., field surveys, remote sensing, interviews) for environmental investigations.

CO3: Apply statistical, geospatial, and analytical tools to analyze and interpret environmental data effectively.

CO4: Demonstrate competence in designing and conducting independent fieldwork, case studies, or environmental impact assessments (EIAs).

CO5: Critically evaluate environmental literature, policy documents, and scientific reports using systematic review techniques.

Credits: 4

Core: Compulsory

Max.Marks: 30+70=100

Min. Passing Marks: 40

Unit	Topic	No. of Lectures (60)
I	Data collection, survey and processing including social and cultural parameters. Statistics: Normal and binomial distribution. Hypothesis testing, t and chi square tests.	12

II	Correlation and regression. Introductory analysis of variance. Multi-criteria analysis. Modeling: Types of models: Mechanistic, economic, simulation etc. Fundamentals of building a model.	12
III	Treatment of 2 or 3 environmental related models: Eutrophication model, global climate change model, wildlife habitat suitability model, air pollution model, ground water pollution model.	12
IV	Remote Sensing: definition, principles, satellites and sensors. Aerial photography to Satellite Remote Sensing. Digital Image processing and image interpretation. GPS principles and applications. Geographic Information System: concepts, database generation and analysis.	12
V	Applications of Remote Sensing-GIS for environmental studies. Case studies, such as, a. Land use / land cover change, Forest degradation, Urban sprawling. b. Mining Hazards / Impacts. c. Forest Fire / Coal Fire Monitoring.	12

Suggested Readings:

1. Demers, Michael N., 2005, M.N. Fundamentals of Geographic Information Systems. Wiley & Sons, 2 Ed. reund.
2. R.J., Wilson W.J., 2003, Statistical Methods, Academic Press.
3. T.M. and Kiefer. R.W., 1999, Remote sensing and image interpretation. 4 Ed. Wiley & Sons.
4. Wainwright. J. & Mulligan. M., 2004, Environmental Modeling. John Wiley & Sons Ltd.



DETAILED SYLLABUS

Programme/Class: Certificate	Year: First	Semester: Second
Subject: Environmental Science		
CourseCode: MSES-201	CourseTitle: Environmental impact and risk assessment	
<p>Courseoutcomes:</p> <p>CO1: Understand the concepts, principles, and legal frameworks of Environmental Impact Assessment (EIA) and Environmental Risk Assessment (ERA).</p> <p>CO2: Identify and analyze potential environmental risks associated with developmental projects and human activities.</p> <p>CO3: Apply various tools and techniques for EIA, including screening, scoping, baseline studies, impact prediction, and mitigation planning.</p> <p>CO4: Evaluate the significance and magnitude of environmental impacts using qualitative and quantitative assessment methods.</p> <p>CO5: Interpret and prepare environmental impact statements (EIS) and risk management plans in accordance with regulatory standards.</p>		
Credits: 4	Core: Compulsory	
Max.Marks:30+70=100	Min.Passing Marks: 40	
Unit	Topic	No. of Lectures (60)
I	Introduction: Defining environmental risk in different perspectives. Principles and procedures: Nature and purpose of environmental impact assessment (EIA). Characteristics of big project. Current issues in EIA.	14
II	Worldwide spread of EIA. EIA regulations in India. Risk Assessment v/s Environmental Impact Assessment. Life cycles Assessment. Strategic Environmental Assessment.	12
III	Process and Methods of EIA: Stages, Scoping, Alternatives, Impact Identification, Establishing the Environmental base line. Impact prediction, evaluation and mitigation. Criteria and standards for assessing significant Impact.	10
IV	Cost- Benefit Analysis and valuation of Environmental Impacts. Public Participation, presentation and review. EIA monitoring and auditing. Practice: Air quality Assessment; Water Impact Assessment; Social Impact Assessment;	14
V	Ecological Impact Assessment; Landscape and visual Impact Assessment; Environmental Impact of surface and underground mining of metals, minerals and fossil fuels. Cumulative Effects Assessment. Issues and problems in environmental assessment.	10

Suggested Books:

1. Glasson J., Therivel R., Chadwick. A., 1994, Introduction to environmental impact assessment- Principles and procedures, process, Practice and prospects. Research Press, Delhi.
2. Therivel. R., 2001, Methods of environmental impact assessment, 2 Ed. Spon Press, New York, With a chapter on GIS and EIA by A.R. Bachiller & G. Wood, p. 381-401.
3. .Petts Judith, 1999, Handbook of environmental impact assessment. Vol. 1, Blackwell Science.

Programme/Class:Certificate	Year:First	Semester:Second
Subject:Environmental Science		
CourseCode:MSES-202	CourseTitle:ENVIRONMENTAL POLLUTION AND HEALTH	
Courseoutcomes:		
<p>CO1: Understand the sources, types, and effects of major environmental pollutants (air, water, soil, noise, and radiation) on ecosystems and human health.</p> <p>CO2: Analyze the pathways and mechanisms through which pollutants impact human physiological systems and contribute to diseases.</p> <p>CO3: Evaluate the interrelationship between environmental degradation and public health issues, including emerging global threats like climate change and pandemics.</p> <p>CO4: Examine pollution monitoring techniques and health risk assessment methods for identifying and managing environmental health hazards.</p> <p>CO5: Interpret national and international standards, regulations, and guidelines for environmental pollution control and public health protection.</p>		
Credits: 4		Core: Compulsory
Max.Marks:30+70=100		Min.Passing Marks: 40
Unit	Topic	No. of Lectures (60)
I	Water sources, quality and standards. Water purification and surveillance of drinking water quality. Infections and diseases spread by contaminated water.	12
II	Air pollution: composition and sources. Air quality monitoring. National and international standards for monitoring air quality. Diseases caused by air pollution. Quality of indoor air and its effect on health. Ventilation: standards, methods and health hazards. Radiation pollution: sources, biological effects and protection. Meteorological environment monitoring. Air temperature and biological effects.	12
III	Noise pollution: source and standards. Noise pollution: health hazard and protective measures. Housing standards and effect on health. Methods of disposal of solid waste. Diseases related to soil pollution. Problems and methods of excreta disposal.	12

IV	Arthropods of medical importance. Vector-borne diseases: transmission and control. Impact of fleas, ticks and mites on health. Zoonotic diseases and their prevention and control. Hospital environment in the context of health and disease.	12
V	Pollution control in India: Government obligation, mechanism and legislation in the context of public health.	12

Suggested Books:

1. Leslie Collier, Balows Albert and Sussman Max, Topley and Wilson's Microbiology and Microbial infections. Oxford University Press. Rd
2. Murray J.F. and Nadel. J.A., 2000, Text book of respiratory medicine, 3 Edn., W.B. Saunders & Co.
3. Park. J.E. and Park. K., 1994, Text book of preventive and social medicine, Banarsi Das & Bhanot, Jabalpur.

Programme/Class: Certificate	Year: First	Semester: Second
Subject: Environmental Science		
Course Code: MSES-203	Course Title: URBAN ECOSYSTEMS	
<p>Course outcomes:</p> <p>CO1: Understand the structure, function, and dynamics of urban ecosystems, including biotic and abiotic components.</p> <p>CO2: Analyze the ecological impacts of urbanization on land use, biodiversity, water systems, and energy flow.</p> <p>CO3: Evaluate the challenges and opportunities of managing natural resources, green spaces, and ecosystem services in urban environments.</p> <p>CO4: Examine the interrelationship between urban planning, infrastructure development, and ecological sustainability.</p> <p>CO5: Assess the role of climate change, pollution, and socio-economic factors in shaping urban ecosystem health and resilience.</p>		
Credits: 4	Core: Compulsory	
Max.Marks: 30+70=100	Min.Passing Marks: 40	

Unit	Topic	No. of Lectures (60)
I	City, region and modernity Places the city in its regional context, both in terms of drawing upon resources and transferring waste. Nature in the city: Parks, Gardens and Public spaces. Examines the principles and techniques through which green spaces are organized in the city to produce 'controlled nature'.	12
II	Infrastructure A variety of infrastructure from sewage and water to transport and communication are studied from an environmental perspective. Planning	12

	and environment Town planning Acts and their environmental aspects are studied across a range of Indian cities. Historical and contemporary developments in urban planning and environmental management are addressed.	
III	Slums and neighborhoods. Examines the housing scenario across large-medium-small cities and the presence of slums as a specific environmental issue in urban contexts. Occupational environment Environmental aspects of a variety of informal and formal work spaces are examined.	12
IV	Pollution and waste Major forms of urban pollution - air, water, noise and land - are explored historically and across various urban sites. Spatial dimensions of waste circulation are explored. Consuming nature Introduce the issue of consumption from a variety of perspectives - materials, symbolic and aesthetic.	12
V	Energy and environment Examines the major techniques for providing energy in urban contexts - generation, transportation, usage, alternatives and environmental impacts. Sustainability and urban futures st Addresses some key challenges facing urban sustainability in the 21 century.	12
SuggestedBooks: <ol style="list-style-type: none"> 1. D'Monte Darryl, 1985, Industry versus Environment Temples or Tombs. Three controversies, Delhi, CSE. 2. T. Veena, 1984, The making of colonial Lucknow Oldenburg. Princeton, Princeton University Press,. Verma Dewan Gita, 2002, Slumming India, Penguin Books, New Delhi. 		

Programme/Class:Certificate	Year:First	Semester:Second
Subject:Environmental Science		
CourseCode:MSES-204	CourseTitle:Natural resources: conservation and management	
Courseoutcomes: CO1: Understand the classification, distribution, and importance of natural resources including water, soil, forest, wildlife, and minerals. CO2: Analyze the ecological, economic, and social factors influencing the use and depletion of natural resources. CO3: Examine traditional and modern approaches to the sustainable management of renewable and non-renewable resources. CO4: Evaluate national and international policies, legal frameworks, and institutional mechanisms for natural resource conservation. CO5: Apply concepts of conservation biology, ecosystem services, and carrying capacity in resource planning and management.		
Credits: 4	Core: Compulsory	
Max.Marks:30+70=100	Min.Passing Marks: 40	
Unit	Topic	No. ofLectures

		(60)
I	Introduction to natural resources and their consumption patterns. Supply and demand of natural resources. Types of natural resources: renewable and non-renewable resources. Time frame. Approaches to natural resource management.	12
II	The nature of soil, characteristics and value. Soil formation, soil profile and soil classification. Soil fertility. Soil conservation and sustainable agriculture: nature of soil erosion; factors affecting soil erosion by water and its control. Alternative agriculture, sustainable agriculture. Land use and environmental problems of soil. Soil surveys and Land use planning.	12
III	Minerals resources, their use, mining and sustainability. Genesis of mineral deposits: endogenous and exogenous processes and their time frame. Environmental impact of mineral production. Mineral conservation strategies: the resource cycle.	12
IV	Non-renewable energy resources: patterns of consumption, issues and options. Global energy source: an overview. Fossil fuels: reserves of coal, its classification and basic geology. Environmental impact of coal mining. Reserves of oil and gas, basic geology. Environmental impact of their production and consumption. Nuclear energy, its sources. Nuclear power plants. Nuclear waste disposal. Geothermal energy: water dominated and vapour dominated systems.	12
V	Types of renewable energy source and their environmental significance. Sustainable development of energy resources.	12
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Craig. J.R., Vaughan. D.J., Skinner. B.J., 1996, Resources of the Earth: origin, use, and environmental impact, 2 Ed. Prentice Hall, New Jersey. 2. Klee. G.A, 1991, Conservation of natural resources.. Prentice Hall Publ. Co., New Jersey. th Owen. 3. O.S, Chiras. D.D, Reganold. J.P, 1998, Natural resource conservation – management for sustainable future, 7 Ed., Prentice Hall. 		

II YEAR

SEM:III													
Batch:2025-26			SEM:III										
S. No.	Course Type	Course Code	Course Name	Teaching Load			Credits	Attendance (5)	Internal Assessment		External Assessment	Total	Remark
				L	T	P			quiz/PT/Assignment (10)	Mid Sem Test (15)			
THEORY and PRACTICAL SUBJECTS													
1	Core Course 9	MSES-301	Atmosphere and global climate change	4	0	0	4	5	10	15	70	100	
2	Core Course 10	MSES-302	Natural & managed ecosystems	4	0	0	4	5	10	15	70	100	
3	DEC 1	MSES-303A/ MSES-303B	A. Biodiversity and conservation biology B. Soil Biology	4	0	0	4	5	10	15	70	100	
4	DEC 2	MSES-304A/ MSES-304B	A. Hydrology and Water Resources B. Environmental Geology	4	0	0	4	5	10	15	70	100	
5	Practical V (Based on CC 9 & 10)	MSES-305P	Atmosphere and global climate change and Biotechnology and Natural & managed ecosystems Lab	0	0	8	4	5	10	15	70	100	
6	Practical VI (Based on DEC 1 & 2)	MSES-306P	Ecotoxicology and environmental health and Environmental biotechnology Lab	0	0	8	4	5	10	15	70	100	
7	OEC 1	MSES-307A/B		2	0	0	2	5	10	0	35	50	
TOTAL CREDITS / ASSESSMENT							26	35	70	90	455	650	

SEM:IV (With Project Work)													
Batch:2025-26				SEM:IV (Without Project Work)									
S. No.	Course Type	Course Code	Course Name	Teaching Load			Credits	Attendance (5)	Internal Assessment		External Assessment	Total	Remark
				L	T	P			quiz/PT/Assignment (10)	Mid Sem Test (15)			
THEORY and PRACTICAL SUBJECTS													
1	Core Course 11	MSES-401	Environmental hazards	4	0	0	4	5	10	15	70	100	
2	DEC 5	MSES-402A MSES-402B	A. Ecotoxicology and Environmental Health B. Environmental Biotechnology	4	0	0	4	5	10	15	70	100	
3	DEC 6	MSES-403A MSES-403B	A. System analysis and modeling B. Environmental engineering	4	0	0	4	5	10	15	70	100	
5	EEC 1	MSES-405A/ MSES-405B	A. Global Energy Scenario and its management B. Waste Management Technology	4	0	0	2	5	10	15	70	100	
6	Project Work	MSES-404D		0	0	4	12	0	0	0	250	250	
TOTAL CREDITS / ASSESSMENT							26	20	40	60	530	650	



DETAILED SYLLABUS

Programme/Class: Certificate	Year: Second	Semester: Third
CourseCode: MSES-301	CourseTitle: Atmosphere and global climate change	
<p>Courseoutcomes:</p> <p>CO1: Understand the composition, structure, and dynamics of the Earth's atmosphere and its role in regulating climate.</p> <p>CO2: Analyze the natural and anthropogenic factors that drive global climate change, including greenhouse gas emissions and land-use changes.</p> <p>CO3: Examine evidence of past and present climate change using scientific data, models, and observational techniques.</p> <p>CO4: Evaluate the environmental, social, and economic impacts of climate change at global, regional, and local levels.</p> <p>CO5: Interpret international climate agreements, protocols, and mitigation/adaptation strategies, including the UNFCCC, Kyoto Protocol, and Paris Agreement.</p>		
Credits: 4	Core: Compulsory	
Max.Marks: 30+70=100	Min.Passing Marks: 40	
Unit	Topic	No. of Lectures (60)
I	Earth Systems: Atmosphere, Hydrosphere, Lithosphere, Biosphere and their linkage. Earth's geological history and development and evolution of the atmosphere; Gaia Hypothesis.	12
II	Atmosphere and climate. Basic atmospheric properties, climatic controls. Climatic classifications and variability. Movement in the atmosphere: global scale, regional scale, local scale. Oceans: General circulation patterns. Air- Sea interaction.	12
III	Global Energy balance: Source, transfer, distribution. Energy balance of the atmosphere. Wind, stability and turbulence; Monsoons; El Nino, Southern Oscillations, cyclones. Natural climate changes: Records of climate change (glacial cycles, ocean sediments, corals, tree rings).	12
IV	Human Impacts on climate: (i) Causes and consequences of Global warming: Greenhouse effect; Global and regional trends in greenhouse gas emissions; Sea level rise; role of oceans and forests as carbon sinks (ii) Ozone depletion-stratospheric ozone shield; Ozone hole.	12
V	Impacts of Climate change: Effects on organisms including humans; effects on ecosystems and productivity; species distribution ranges; spread of diseases; Extinction risk for temperature-sensitive species; UV effects Climate change and Policy: Montreal Protocol; Kyoto Protocol; Carbon trading; clean development mechanisms.	12
<p>SuggestedBooks:</p> <p>1. Barry, R. G., 2003. Atmosphere, weather and climate. Routledge Press, UK Critchfield, Howard J., 1998, General climatology, Prentice Hall India Pvt. Ltd., New Delhi.</p>		

2. Firor, J., and J. E. Jacobsen, 2002. The crowded greenhouse: population, climate change and creating a sustainable world. Yale University Press. Glantz, M. H., 2003. Climate Affairs: a primer. Island Press. 24
 3. Harvey D., 2000, Climate and Global Climate Change, Prentice Hall. Kump, L. R., Kasting, J.F., and Carne, R. G., 2004. The Earth System. 3 rd l

Programme/Class: Certificate		Year: Second	Semester: Third
Course Code: MSES-301		Course Title: NATURAL & MANAGED ECOSYSTEMS	
Course outcomes:			
CO1: Understand the structure, function, and dynamics of natural ecosystems such as forests, grasslands, wetlands, deserts, and aquatic systems.			
CO2: Analyze the ecological processes, energy flow, and nutrient cycling within natural and human-managed ecosystems.			
CO3: Examine the impacts of human interventions, land-use change, and resource extraction on ecosystem stability and biodiversity.			
CO4: Evaluate principles and practices of ecosystem management, restoration, and conservation in both natural and managed contexts.			
CO5: Distinguish between traditional and modern ecosystem management approaches, including agroecosystems, urban ecosystems, and protected area management.			
Credits: 4		Core: Compulsory	
Max. Marks: 30+70=100		Min. Passing Marks: 40	
Unit	Topic		No. of Lectures (60)
I	Introduction to Ecosystems: concepts; components; flow of energy; productivity, cycling of materials and nutrients, Food chain.		12
II	Communities: concept; development; structure; niche; regulation of community structure. Ecosystem dynamics and functioning: role of biodiversity in patterns and processes of communities and ecosystems; stability, disturbance and resilience.		12
III	Ecosystem types and their distribution. Classification; Major ecosystems of the world (forests, grasslands, wetlands, oceans, rivers and lakes, deserts). Managed Ecosystems; Agri-Ecosystems, Aquaculture, Urban Ecosystems and Community Forests.		12
IV	Ecosystems and Human well-being: Ecosystem services; Natural and Human induced changes in Ecosystems and their consequences on human well-being.		12
V	Sustainable Management: Concept of sustainability; Mechanisms to ensure sustainability of Ecosystems – Changes in institutional and Environmental governance framework; Economic and financial interventions; Social and Behavioral changes; Technological options; Design of effective decision making process; Vision for an ecologically sustainable future.		12

1. Clapham Jr., W.B., 1983, Natural Ecosystem: Chapters I, II, III and IV. Macmillan Publishers, London
2. Gadgil Madhav, 2004, Ecological Journeys. The Science and Politics of conservation in India, Permanent black, Delhi.
3. Heywood, V.H. (Executive Editor), 1995, Global Biodiversity Assessment: Chapters 5 and 6. UNEP, University Press, Cambridge st
4. Jennifer, A., Burch. W.R., Conover, B. and Field, D., 1998. Ecosystem Management: Adaptive strategies for Natural Resources organizations in the 21 Century. Taylor and Francis, London. Reid,
5. W.V. et al (Ed.), 2005, Ecosystems and Human well-being: Synthesis. p.1-37. Millennium Ecosystem Assessment, World Resource Institute, Island Press, Washington DC.
6. Samson, B.F, and Knoff, F.L., 1996, Ecosystem Management. Springer-Verlag, New York.

Discipline Elective Course (DEC)

Programme/Class:Certificate	Year:Second	Semester:Third
CourseCode:MSES-303A	CourseTitle:Biodiversity and conservation biology	

Unit	Topic	No. of Lectures (60)
	Course Outcomes: CO1: Understand the concepts, levels, and importance of biodiversity in ecosystems. CO2: Learn about the causes of biodiversity loss and the major threats to species and habitats. CO3: Gain knowledge of conservation strategies, including in-situ and ex-situ methods for protecting biodiversity. CO4: Understand the role of conservation biology in sustainable development and ecosystem management.	
I	Concepts: Organic Evolution through geological time scale. Ecosystems, Biomes etc. Levels of Biodiversity: Community diversity (alpha, beta and gamma biodiversity), Gradients of Biodiversity (latitudinal, insular), Ecosystems diversity: biomes, mangroves, coral reefs, wetlands and terrestrial diversity (equilibrium mix of G and W.).	12
II	Species diversity: richness and evenness, loss of species. Magnitude of biodiversity (Global and Indian data). Direct and indirect benefits, Bioprospecting (molecular techniques like RAPD, RFLP, AFLP, DNA sequencing etc).	12
III	Genetic diversity: sub species, breeds, race, varieties and forms. Variation in genes and alleles at DNA sequence levels (selected case studies). Microbial	12

	diversity and useful prokaryotic genes. Speciation (amount of genetic variation is the basis of speciation). Consequences of monotypic agricultural practice (Detailed case studies).	
IV	History of Conservation movements: International and National. Ecologically relevant parameters (viable population, minimum dynamic area, effective population size, metapopulations); reproductive parameters in conservation (breeding habitats, mating systems, inbreeding depression, genetic bottlenecks, genetic constraints).	12
V	Methods of conservation. In situ (Biosphere reserves, National Parks, Sancturaries, Sacred groves etc) & ex situ (Botanical gardens, Zoological gardens, Gene banks, Pollen, seed and seedling banks, tissue culture and DNA banks etc) modes of conservation.	12

Suggested Books:

1. Daily, G.C., Ed., 1997, Nature's Services: Societal Dependence on Natural Ecosystems. Island Press,
2. Washington, D.C. Dobson, A.P., 1996, Conservation and Biodiversity. Scientific American Library, New York,
3. NY. Gaston, K.J. and J.I. Spicer, 1998, Biodiversity: An Introduction. Blackwell Science, London, UK.
4. Groom bridge, B., and M. Jenkins, 2000, Global Biodiversity: Earth's Living Resources in the 21 Century. World Conservation Press, Cambridge, UK.
5. IUCN, 2004, Red list of threatened species. A global species assessment. IUCN, Gland, Switzerland
6. Loreau, M., and P. Inchausti, 2002, Biodiversity and Ecosystem functioning: Synthesis and Perspectives. Oxford University Press, Oxford, UK. rd Primack,

Programme/Class: Certificate	Year: Second	Semester: Third
CourseCode: MSES-303B	CourseTitle: Soil Biology	

Unit	Topic	No. of Lectures (60)
	<p>Course Outcomes:</p> <p>CO1: Understand the diversity, structure, and functions of soil organisms in different soil ecosystems.</p> <p>CO2: Learn the biological processes that influence soil formation, nutrient cycling, and soil fertility.</p> <p>CO3: Gain knowledge about the interactions between soil microorganisms, plants, and the environment.</p> <p>CO4: Understand the role of soil biology in sustainable agriculture, soil health management, and environmental conservation.</p>	

I	Soil genesis and provenance, Pedosphere, Soil organic matter: sources, composition, microbial decomposition of organic matter, Humus formation	12
II	Soil as a habitat for organisms: micro flora and soil fauna, ecological interactions. Taxonomy and biology of soil organisms, Position and role of soil fauna in soil, ecological niche. Economic importance of soil microbes.	12
III	Role of soil biota in nutrient cycles: Carbon, Nitrogen, Sulphur, Phosphorous cycles. Soil mutualistic symbioses – Structure of plasma membrane and fluxes across it. Mycorrhizal symbioses and Nitrogen fixing symbioses, Underground interactions: Rhizosphere, root exudates	12
IV	Environmental problems related to soils in India: desertification, salinization, erosion.	12
V	Bioremediation of contaminated soils and ground water, Fate of plant allelochemicals in soil, Composting, a value addition to our wastes.	12

Suggested Books:

1. Alexander, M., 1977, 2 Edn., Introduction to Soil Microbiology, Wiley John.
2. Alexander, M., 1994, Biodegradation and Bioremediation, Academic Press. 27 nd Ed.,
3. Fundamentals of Soil Ecology, Academic Press.
4. Coleman and Crossley, 2004, 2 Killham, K., 1994, Soil Ecology, Cambridge University Press.

Programme/Class:Certificate	Year:Second	Semester:Third
CourseCode:MSES-304A		CourseTitle: HYDROLOGY AND WATER RESOURCES

Unit	Topic	No. of Lectures (60)
	<p>Course Outcomes:</p> <p>CO1: Understand the basic concepts of the hydrological cycle, water balance, and surface and groundwater resources.</p> <p>CO2: Learn about the measurement, analysis, and management of water resources for sustainable use.</p> <p>CO3: Gain knowledge of hydrological modeling, flood and drought management, and watershed management techniques.</p> <p>CO4: Understand the challenges of water resource development, including water quality, conservation, and policy planning.</p>	

I	introduction: The hydrologic cycle; Structure and properties of water, Inventory of Earth's water, quality and quantity. Limits of cations and anions in portable water including fluoride and arsenic, phosphate, nitrate and heavy metals. Application of isotopes in hydrology. Hydrogeology of India.	12
II	Surface water resources: precipitation, infiltration, water balance, Evapo-transpiration and runoff, Drainage basin.	12
III	Groundwater resources: rock properties affecting ground water, vertical distribution of ground water, zone of saturation. Darcy's law: permeability, transmissivity and storage coefficient. Viscous character of groundwater flow. Geologic formations as aquifers, type of aquifers. Distribution of water - local, regional and global. Ground water exploration.	12
IV	Environmental Influences on water resources: surface and groundwater resources of arid and semiarid regions, Snowmelt hydrology from glaciers, fluctuations due to urbanization, Evapo-transpiration and tides. Recent development in surface and groundwater resources monitoring and assessing processes. Salinity ingress in ground water. Water logging and soil salinity-conjunctive use of surface water and ground water.	12
V	Water resource management: Flood and flood plain management; Water-shed management, water harvesting and artificial recharge to ground water; water pollution and water treatment. Wetland and riparian management; forest management on water resources. Environmental issues: River linking debate.	12
SuggestedBooks: <ol style="list-style-type: none"> 1. Aggarwal, A., 1991, Floods, Floodplains and Environmental Myths. Centre for Science and Environment, New Delhi. nd 2. Andrew D. Ward and Stanley Trimble, 2004, 2 Ed., Environmental Hydrology, Lewis Publishers. 3. Karanth, K.R.C., 1988, Ground Water: Exploration, Assessment and Development. Tata-Mcgraw Hill, New Delhi. 4. Mahajan, G., 1989, Evaluation and Development of Groundwater. Ashish Publishing House, New Delhi. Rao, K.L., 1982, India's water wealth. Orient Longman, Delhi. 5. Subramaniam V., 2002, Text Book of Environmental Science, Narosa Publishing House, Delhi. 		

Programme/Class:Certificate	Year:Second	Semester:Third
CourseCode:MSES-304B		CourseTitle:ENVIRONMENTAL GEOLOGY

Unit	Topic	No. of Lectures (60)
	Course Outcomes: CO1: Understand the fundamental concepts of geology and their relevance to environmental studies. CO2: Learn about natural hazards such as earthquakes, landslides, floods, and volcanic eruptions and their impacts on human society.	

	<p>CO3: Gain knowledge of geological processes affecting soil, water, and land resources.</p> <p>CO4: Understand strategies for sustainable land use, environmental management, and mitigation of geological hazards.</p>	
I	Planet Earth: Earth in the solar system; differentiation of the earth into core, mantle, crust, hydrosphere and atmosphere; rock-forming, ore-forming and soil-forming minerals; energy, mineral, water and soil resources.	12
II	Earth processes: Plate-tectonic processes, rock-forming and ore-forming processes, hydrologic, weathering and erosional processes; development of large-scale physiographic features such as oceans, land, mountains, plateau, floodplains and deltas. Rivers and their relation to geology and climate; erosional, transportational and depositional processes of water, air, waves and glaciers.	12
III	Resources: Concepts of resources and reserves in energy, mineral and water resources; geological constraints in their availability and use; environmental consequences of their exploitation to air, water, soil, climate and life.	12
IV	Natural hazards: Floods, landslides, earthquakes-tsunami and volcanism, cyclones, coastal erosion and sea level changes; impact of urbanization on the rate of these processes; general methods to identify the hazard potential, to mitigate and to cope with natural processes.	12
V	Land use: Land evaluation and land use planning for construction and waste disposal; landscape geochemistry and human health; Desertification and associated problems.	12
<p>SuggestedBooks:</p> <ol style="list-style-type: none"> 1. Keller. Edward A, 1996, Introduction to Environmental Geology, Prentice Hall, Upper Saddle River, New Jersey 2. Kesler, S. F. 1994, Mineral resources, economics and the environment. Upper Saddle River, NJ: Prentice Hall. 3. Owen., Oliver S, Chiras. Daniel D, Reganold. John P., 2002, Natural Resource Conservation, 7th Ed., Prentice Hall, Upper Saddle River, New Jersey 		

Open Elective Course (OEC)

Programme/Class: Certificate	Year: Second	Semester: Third
CourseCode: MSES-307A		CourseTitle: Air Monitoring and Management

Unit	Topic	No. of Lectures (30)
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	Course Outcomes: CO1: Understand the sources, types, and effects of air pollutants on health and the environment. CO2: Learn the principles and techniques of air quality monitoring and measurement. CO3: Gain knowledge of air pollution control technologies, strategies, and regulatory frameworks. CO4: Understand approaches for sustainable air management and mitigation of air pollution in urban and industrial settings.	
I	The atmosphere: Natural constituents of air; Vertical structure; Water in the atmosphere; Concepts and Measurements of atmospheric boundary layer Air pollutants and its effect: Emission sources of primary pollutants, Volatile organic compounds, Persistent organic pollutants; Secondary pollutants and their sources; Emission factors; Natural and anthropogenic particle sources; Effect of air pollutants on biota and materials.	10
II	Measurement of gases and particulates: Objectives of Air Pollution Monitoring; Selection of monitoring locations; Sampling requirements; Measurement techniques; Gas sampling and measurement systems; Particle sampling and measurement systems. 6. Representation of air quality data: Period averages; Diurnal and seasonal variations; Frequency distributions;	10
III	Pollutant standards indices; Air pollution indices; Emission inventories its concept and methodologies; Air quality norms and standards. Control of Air pollution: Air pollution prevention and control technologies; Gas specific removal technologies; Removal of particulate matter, liquid droplets and mist; Green technology.	10
SuggestedBooks: <ol style="list-style-type: none"> 1. Schnelle, Jr., K. B. and Charles A. Brown (2002) Air Pollution Control Technology Handbook. CRC Press. 2. 2 Colls, J. (2002) Air Pollution. Spon Press, an imprint of the Taylor and Francis Group. 3. Masters, G.M. (2004) Introduction to environmental engineering and science, Prentice-Hall of India Pvt. Ltd., New Delhi. 4. Kiely, G., (2007) Environmental Engineering, Tata McGraw-Hill. 		

Programme/Class: Certificate	Year: Second	Semester: Third
CourseCode: MSES-307B	CourseTitle: Water Monitoring and Management	

Unit	Topic	No. of Lectures (30)
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	Course Outcomes: CO1: Understand the sources, types, and impacts of water pollution on human health and ecosystems. CO2: Learn the techniques and principles of water quality monitoring and analysis. CO3: Gain knowledge of water pollution control methods, treatment technologies, and regulatory standards. CO4: Understand sustainable water management practices for conservation, resource planning, and ecosystem protection.	
I	Distribution of water and hydrological cycle: Global distribution of water, hydrological cycle and its components, variables for water balance on earth Properties of water and water quality standards: Physico-chemical and biological properties of surface and subsurface water, National and International water quality standards	10
II	Sources of water pollution and its effect: Major sources of water pollution and its effect on surrounding water bodies, flora and fauna, and aquatic ecosystem Water management: Water management strategies, surface and ground water resources and its management, problems and solutions, future challenges	10
III	Watershed development and analysis: Definition and concept of watershed, watershed development, watershed morphometric analysis and its applications Water Conservation and restoration: Rain water harvesting, artificial recharging of ground water and recycling of domestic and industrial waste waters	10
Suggested Books: [1] Pahl-Wostl, Claudia; Kabat, Pavel; Möltgen, Jörn (Eds.) (2008) Adaptive and Integrated Water Management. [2] Hlavinek, P.; Kukharchyk, T.; Marsalek, J.; Mahrikova, I.(Eds.) (2006) Integrated Urban Water Resources Management. [3] B.D. Tripathi (2001) Water pollution: An experimental approach CBS, Publishers. [4] Boyd, C. E. (2012) Water quality: an introduction. Springer Science & Business Media.		

DETAILED SYLLABUS

Programme/Class:Certificate	Year:Second	Semester:Fourth
CourseCode:MSES-401	CourseTitle:Environmental hazards	
Courseoutcomes: CO1: Understand the types, causes, and characteristics of environmental hazards, including natural and anthropogenic hazards. CO2: Analyze the physical, chemical, biological, and technological hazards and their effects on ecosystems, infrastructure, and human health.		

<p>CO3: Evaluate hazard assessment methodologies, risk analysis tools, and vulnerability mapping techniques.</p> <p>CO4: Examine the socio-economic and environmental impacts of major hazards such as earthquakes, floods, droughts, cyclones, industrial accidents, and chemical spills.</p> <p>CO5: Interpret national and international frameworks for disaster risk reduction, including early warning systems and policy interventions.</p>		
Credits: 4		Core: Compulsory
Max.Marks:30+70=100		Min.Passing Marks: 40
Unit	Topic	No. of Lectures (60)
I	Concept of hazard, disaster, risk, vulnerability, exposure and response. Distinction between natural hazards and anthropogenic environmental disturbances, Hybrid hazards.	12
II	Environmental Hazards: Classification, Causes and Distribution. Natural Hazards: Geological Hazards: Earthquakes, Volcanoes, Mass-movement; Tsunami.	12
III	Hydrological Hazards: Floods, Droughts, Water Quality, Contamination, Arsenic problem, Cyclones, Hurricanes Atmospheric/Climatic Hazards: Extreme weather events, Global Climatic change.	12
IV	Man made Hazards: Biophysical Hazards: Frost Hazards in agriculture, epidemics, wildfires Technological Hazards: Nature and significance. Lessons from Bhopal and Chernobyl disasters. Modelling of Hazards: Hill slopes and landslides.	12
V	Disasters and Hazard Management: Human and ecological impacts; Risk assessment and vulnerability analysis; National preparedness and adaptation strategies; Hazards policies and agencies; Land use classification. Role of GIS and remote sensing in surveillance, monitoring, risk assessment, estimation of losses and planning.	12
<p>Suggested Books:</p> <ol style="list-style-type: none"> 1. Bell. F.G, E & FN Spon, 1999, Geological Hazards: Their Assessment, Avoidance and Mitigation, e Books der ULB Darmstadt. 2. Burton. I, Kates. R.W and White. G.F, 1993, Environment as Hazard Guilford Press. Casale. R and Margottini. C. (Ed.), Springer, 2004, Natural Disasters and Sustainable Development 3. Hewitt. K., 1997, Regions of risk, Longman Press. 		

Discipline Elective Course (DEC)

Programme/Class:Certificate	Year:Second	Semester:Fourth
CourseCode:MSES-402A		CourseTitle:Ecotoxicology and environmental health
Credits: 4		Core: Compulsory

Max.Marks:30+70=100		Min.Passing Marks: 40
Unit	Topic	No. of Lectures (60)
	Course Outcomes: CO1: Understand the types, causes, and characteristics of environmental hazards, including both natural and anthropogenic hazards. CO2: Analyze physical, chemical, biological, and technological hazards and their effects on ecosystems, infrastructure, and human health. CO3: Evaluate hazard assessment methodologies, risk analysis tools, and vulnerability mapping techniques. CO4: Examine the socio-economic and environmental impacts of major hazards, including earthquakes, floods, droughts, cyclones, industrial accidents, and chemical spills.	
I	Ecotoxicology as a Synthetic Science; Major classes of Environmental Pollutants; Inorganic, Heavy Metals, Organics, Organometalics, Radioactive Isotopes, Gases	12
II	Routes of Entry into Ecosystems – Surface waters, Land, Atmosphere; Long-range movement and global transport of pollutants. Fate of pollutants in Ecosystems: Biotransformation, Bioaccumulation & Biomagnification. Test organisms used in Bioassays. Biomonitoring: Definition of toxicity, F, As, Hg problems	12
III	Toxicity Testing, Concept of Dosimetry: lethal, sub-lethal & chronic tests, dose response curves, LC50, MATC-NOEC, Brief statistical methodology Toxicant Effects: - Cellular, organismic, population & Ecosystem-Level Effects; Global Effects – Acid rain etc.	12
IV	Toxicology & Epidemiology and occupational health Sources: Solid & Hazardous wastes, untreated sewage, Automobile exhausts, Industrial Effluents, Industrial emissions into atmosphere, Agricultural run-off of Pesticides Environmental Carcinogens, Mutagens, Asbestos issues Human adaptation to cold and hot climates, high altitude environment and man-made environments.	12
V	Water pollution – Caused diseases (Gastroenteritis, Hepatitis etc.). Air pollution caused diseases (allergies, respiratory diseases). Food-borne diseases (Food poisoning, parasites etc). Vector transmitted diseases. Radioactive effects. Risk assessment.	12
Suggested Books: 1. Newman, M.C, Lawrence, C.A., and Unger. M.A., 2002. Ecotoxicology: Fundamentals of Ecotoxicology, 2 Ed., CRC Press, Boca Raton, Florida. 2. Walker, C.H., Hopkin, S.P., Sibly, R.M., and Peakall, D.B. 2001. Principles of Ecotoxicology. 2 Taylor & Francis, London.		

Programme/Class: Certificate		Year: Second	Semester: Fourth
Course Code: MSES-402B		Course Title: Environmental biotechnology	
Credits: 4		Core: Compulsory	
Max. Marks: 30+70=100		Min. Passing Marks: 40	
Unit	Topic	No. of Lectures (60)	
	<p>Course Outcomes:</p> <p>CO1: Understand the principles of environmental biotechnology and the role of microorganisms in bioremediation, waste management, and pollution control.</p> <p>CO2: Analyze the application of biotechnological tools for treatment of industrial effluents, wastewater, and solid waste.</p> <p>CO3: Evaluate the use of genetically engineered microbes and enzymes for degradation of environmental pollutants.</p> <p>CO4: Examine the impact of biotechnological interventions on ecosystems, human health, and sustainable development.</p> <p>CO5: Interpret national and international regulations, guidelines, and policies related to environmental biotechnology and biosafety.</p>		
I	Structure and perpetuation of nucleic acids: Pioneering experiments leading to development of molecular genetics, Fine structure of gene, DNA replication models, mechanism of replication, enzymes involved in replication.	12	
II	Introduction to nature of genetic information and gene expression: Transcription of DNA; RNA polymerase, initiation, chain elongation, termination, post-transcriptional modifications. The genetic code; protein synthesis: tRNA as adaptor molecule, ribosome structure, ribosomal genes, initiation, elongation and termination of protein synthesis. Inhibition of protein synthesis.	12	
III	Recombinant DNA technology: Early discoveries, restriction endonucleases, ligases, modification enzymes, DNA and RNA markers, cloning and expression vectors (plasmids, bacteriophage, phagmids, cosmids, artificial chromosomes), selection of recombinant clones, DNA sequencing, gene probes. cDNA synthesis and cloning (mRNA enrichment, reverse transcription, DNA promoters, linkers, adaptors and their chemical synthesis, library construction and screening). Nucleic acid microarrays.	12	
IV	Wastewater Treatment: Water as a scarce natural resource, Measurement of water pollution, sources of water pollution. Wastewater treatment: anaerobic, aerobic process, methanogenesis, bioreactors, cell and protein (enzyme) immobilization techniques. Treatment schemes for waste water, dairy, distillery, tannery, sugar, antibiotic industries.	12	

V	Solid waste treatment: Sources and management (composting, wormiculture and methane production, landfill. Hazardous waste treatment. Biofuels.	12
Suggested Books: <ol style="list-style-type: none"> 1. Gardner, Simmonds, Snustad, 1991, Principles of Genetics. John Wiley, Eighth Edition. 2. Mohapatra. P. K., 2006, Text Book of Environmental Biotechnology. I K International. 3. Olguin, E., Sanchez, G. and Hernandez, E., 1999, Environmental biotechnology and cleaner bioprocesses, Taylor & Francis, London. 4. Rittman, B. E., and McCarty, P. L., 2001, Environmental Biotechnology. Principles and applications. McGraw-Hill, New York. 		

Programme/Class: Certificate	Year: Second	Semester: Fourth
Subject: Environmental Science		
Course Code: MSES-403A	Course Title: Systems analysis and modeling	
Credits: 4	Core: Compulsory	
Max.Marks: 100	Min.Passing Marks: 40	
Unit	Topic	No. of Lectures (60)
	Course Outcomes: CO1: Understand the fundamental concepts of systems, modeling approaches, and the role of systems analysis in solving complex problems. CO2: Analyze different types of models, including deterministic, stochastic, and simulation models, for various engineering and management applications. CO3: Apply mathematical, computational, and graphical techniques to model real-world systems and evaluate their behavior. CO4: Evaluate system performance, stability, and optimization using quantitative and qualitative modeling tools.	
I	Introduction: Definitions and concepts of system, sub-system, variables and parameters, systems analysis, modeling and simulation. Linear vs. non-linear models; Non-linear forecasting. Prey-predator systems, Environmental systems. Time series analysis.	12
II	Types of systems: open and cybernetic systems; feedback; Ecosystem as a cybernetic system; Critical points of a system; stability of critical points. Limitations of modeling.	12
III	Models in Ecology: Stochastic and Deterministic model; Development of Ecological models. Fundamental interactions in ecology: predator-prey, competition, mutualism and interference.	12

IV	Models in Ecosystem Analysis, Synthesis and forecasting: statistical regression approach, differential equation approach and computational approaches, Lotka-Volterra model.	12
V	Air and water quality modelling Introduction to computational technology: Fuzzy logic; artificial neural networks; Genetic algorithms; Evolutionary algorithm, Natural Distribution functions.	12
Suggested Books: <ol style="list-style-type: none"> 1. Gallager R., 1996, Discrete Stochastic Processes, Kluwer Academic Publishers. Grant, 2. W.E., Pederson, E.K. and Sendra, L.M., 1997, Ecology and Natural Resource Management: Systems Analysis and Simulation, John Wiley, New York. 3. Jorgensen, S.E. Miller, F., (Ed.), 2000, Hand Book of Ecosystem Theories and Management, Section-I and 11.4 of Section II. CRC press, 4. Florida. Recknagal, F., (Ed.), 2003, Ecological Informatics, chapters I, II, III and IV. Springer, Germany. 		

Programme/Class:Certificate		Year:Second	Semester:Fourth
CourseCode:MSES-403B		CourseTitle:Environmental engineering	
Credits: 4		Core: Compulsory	
Max.Marks:30+70=100		Min.Passing Marks: 40	
Unit	Topic	No. of Lectures (60)	
	Course Outcomes: CO1: Understand the principles of environmental engineering, including the interaction between human activities and natural systems. CO2: Analyze the sources, characteristics, and impacts of environmental pollutants on air, water, and soil. CO3: Evaluate methods for water and wastewater treatment, solid and hazardous waste management, and pollution control technologies. CO4: Examine environmental monitoring techniques, modeling tools, and sustainable engineering practices for ecosystem protection.		
I	Introduction to Engineering Fundamentals: Principles of environmental quality objectives, standards and guidelines; Environmental processes: Engineered systems and policies; Professional directions in environmental engineering; Material Balances and Separations. Science of environment: physical & chemical processes, Environmental Biology, Basics of Microbiology	12	
II	Treatment technology and control: Aerobic and anaerobic processes; aeration, coagulation and flocculation, sedimentation, filtration, disinfection. Tertiary treatment technologies. Technological considerations and Engineering	12	

	applications	
III	Water Treatment Processes; Water transmission, distribution, storage. Wastewater Flow rates & Collection; Wastewater Treatment Processes. Constructed wetlands.	12
IV	Air Pollution Control: Treatment of Emissions; Dispersion; Control of Moving Sources; Air Pollution control costs.	12
V	Solid waste management: Characteristics and collection system. Separation, processing and conversion. Land filling. Future opportunities. Hazardous Wastes: nuclear waste, biomedical waste, chemical waste. Hazardous waste management. Waste Minimization; Pollution Prevention and control strategies	12
<p>Suggested Books:</p> <ol style="list-style-type: none"> 1. Henry Glya, J. and Heinke, 2004, Gary W. Environmental Science and Engineering. Pearson low priced edition. 2. Kiely, G., 1998, Environmental Engineering, Irwin McGraw Hill, Boston. 3. Masters, M.G., 1998, 2nd Edition, Introduction to Environmental Engineering and Science, Prentice Hall, London. 4. Peavy, H.S., Rowe, D.R. and George, T., 1987, Environmental Engineering, McGraw Hill, New York. 5. Vesilind, P.A., 1997, Introduction to Environmental Engineering. PWS publishing, Boston. 		

(EEC)

Programme/Class: Certificate	Year: Second	Semester: Fourth
Course Code: MSES-405A		Course Title: Global Energy Scenario and its Management
Unit	Topic	No. of Lectures (30)
	<p>Course Outcomes:</p> <p>CO1: Understand the global energy landscape, including the availability, consumption patterns, and types of conventional and renewable energy resources.</p> <p>CO2: Analyze the environmental, economic, and social impacts of different energy production and consumption methods.</p> <p>CO3: Evaluate energy efficiency techniques, sustainable energy technologies, and strategies for reducing energy-related environmental footprints.</p> <p>CO4: Examine policies, regulations, and international agreements related to energy management and climate change mitigation.</p>	

I	Sources of energy: Conventional and non-conventional, Global patterns of energy consumption, rising demand and supply, Energy needs of growing Economy, Long Term Energy Scenario. Solar energy: Earth Sun Relationship (Angles and Models, Earth and Sun Relation), Measurement, and technologies based upon solar energy.	10
II	Wind energy: Structure and function of wind turbines and associated technologies their scope and potential in India. Geothermal and Ocean energy: Scope and potential in India, OTEC System, ocean wave energy system, ocean tidal energy system.	10
III	Electrical and Thermal Energy: Electricity tariff, Load management and Maximum demand control, Power factor; Thermal energy contents of fuel, Temperature and Pressure, Heat capacity, Sensible and Latent heat, Evaporation, Condensation, Steam, Moist air and Humidity, Heat transfer, Units and conversion. 6. Energy Pricing, Energy Sector Reforms, Energy, and Environment: Air Pollution, Climate Change, Energy Security, Energy Conservation, and its Importance,	10

Suggested Books:

- [1] John W Twidell and Anthony d Weir (2006) Renewable Energy Resources, Published by E and F N Spon Ltd, London. 2006.
 [2] W.R.Murphy & G.McKay (2007) Energy Management. Edition: ISBN: 9788131207383.
 [3] S. C. Bhatia (2014) Advanced Renewable Energy Systems (in 2 Vols.). Edition: 2014. ISBN: 9789380308432.
 [4] Staniskis, Jurgis Jayaraman, C (2010) Cleaner Production and Energy Conservation for Sustainable Development Nam S&T Centre. Edition : 2010. ISBN : 9788170356363.

Programme/Class:Certificate	Year:Second	Semester:Fourth
CourseCode:MSES-405B	CourseTitleWaste Management Technology	
Unit	Topic	No. of Lectures (30)
	<p>Course Outcomes: CO1: Understand the principles of waste management, including types, sources, and characteristics of solid, liquid, and hazardous wastes. CO2: Analyze methods for collection, segregation, treatment, and disposal of municipal, industrial, and biomedical wastes. CO3: Evaluate technological solutions for recycling, resource recovery, composting, and energy generation from waste. CO4: Examine environmental and health impacts of improper waste management and strategies for sustainable waste handling.</p>	

I	Introduction: Generation, Sources, Types, classification and composition of solid wastes, Problem associated with improper waste management, Waste management system in India. Composition of solid waste: Physical and chemical composition of solid waste, waste generation rates, collection, transportation and storage	10
II	Solid waste Management: Plan, waste minimization technologies, 4 R (recycle, reuse, recover and reduce) principle, Incineration, Land filling. Waste to energy conversion: Pyrolysis, Composting, Biomethanation, and recycling; Refused Derived Fuels, Land fill gas (LFG).	10
III	Hazardous Waste Management: Sources, Types and Classification of hazardous waste and its management, Guidelines for HWM. Biomedical Waste: Sources, Types and Classification of Biomedical Waste and its management.	10

Suggested Books:

- [1] Frank Kerith, McGraw Hill (1994) Handbook of solid management, Inc. USA.
 [2] Charles A. Wentz, McGraw-Hill (1989) Hazardous waste management, New York.
 [3] Jagbir Singh, A. L. Ramanathan (2009) Solid Waste Management Paperback. I K International Publishing House Pvt. Ltd (12 January 2009) ISBN-10: 9380026420 ISBN-13: 978-9380026428
 [4] George Tchobanoglous, Hilary Theisen, S. A. Vigil (1993) Integrated solid waste management: engineering principles and management issues McGraw-Hill.

