UNIVERSITY OF MYSORE

B.Sc., Degree Course

Environmental Science
(Three Year – Six Semester Scheme)
(III and IV Semester)

MODEL CURRICULUM (UNDER-GRADUATE) 2025-26
BACHELOR OF SCIENCE (B.Sc.) IN ENVIROMENTAL SCIENCE
SYLLABUS
(With New Regulations)

Environmental Science
B, Sc., III and IV Semester
(2025 - 26 on wards)
List of the Papers - Environmental Science

Papers	Core Course Discipline Specific Course (DSC)	Ability Enhanancement Compulsory Course (AECC)	Discipline Specific Elective (DSE)	Skill Enhanancement Course (SEC)	L	T	P	Total Credit
Third Semester ENVIRONMENTAL GEOLOGY AND SOIL SCIENCE								
SENDSC301	**ENVIRONMENTAL GEOLOGY AND SOIL SCIENCE**	-	-	-	**3**	-	-	**3**
SENDSC302	**PRACTICAL**	-	-	-	-	-	**4**	**2**
SENEC301			ENVIRONMENT AND SUSTAINABLE AGRICULTURE		**3**	-		**3**
SENEC302			GLOBAL WARMING AND ITS IMPACTS		**3**	-	-	**3**
IV Semester								
SENDSC401	**ENVIRONMENTAL CHEMISTRY**	-	-	-	**3**	-	-	**3**
SENDSC402	**PRACTICAL**	-	-	-	-	-	**4**	**2**
SENCP401				**Environmental Assessment and Monitoring**		-	**4**	**2**
SENEC402			**ENVIRONMENTAL MANAGEMENT**		-	-	-	**3**

The aims and Objectives of B.Sc. Environmental Science is to:

- Provide students with the scope to develop knowledge base covering all attributes of the environment and enable them to attain scientific/technological capabilities to find answers to the fundamental questions before the society with regards to human action and environmental effects with due diligence.

- Enhance the ability to apply this knowledge and proficiency to find solutions relating to environmental concerns of varied dimensions of present times

- Provide with a direction and technical capability to carry on lifelong learning and show teamwork and collaborative endeavour, and decision making

- Improve the employability of the graduates including the enhancement of self employment potential and entrepreneurial aptitude, and fill the technical resource gap especially in the Indian context

- Help graduates appreciate requirement of framing environmental policy guidelines

- Motivate graduates to appreciate that they are an integral stakeholder in the environmental management of India irrespective of their future jobs or working environments.

- Help graduates to understand the concerns related to Sustainable Development Goals (SDGs) and the Indian obligations

Program Learning Outcomes of B.Sc. Environmental Science is to :

- Ability to recognize the need for learning the topic and develop foundational knowledge on the topic.
- Ability to develop critical thinking and problem solving skills to solve interdisciplinary issues related to the topic.
- Ability to understand the relationships between natural and man-made systems
- Ability to apply technical methods and innovative techniques in classroom, field and laboratory to analyze scientific data
- Ability to develop lifelong learning and professional skills
- Ability to design and execute a scientific project, write scientific reports, develop research and communication skills
- Ability to spread awareness about the environment around us, sustainable development and conduct outreach activities
- Ability to gain empirical knowledge on the topic and contribute in decision making processes

MODEL CURRICULUM (UNDER-GRADUATE) 2024-25
DEGREE: BACHELOR OF SCIENCE (B.Sc.) IN ENVIROMENTAL SCIENCE
SYLLABUS
(With New Regulations)
III Semester Theory Syllabus

Year - 2	**Course Code**	**LTP/Credits:** 3 0 0
Sem – III	**Paper Title: ENVIRONMENTAL GEOLOGY AND SOIL SCIENCE**	**Total Teaching Hours:** 48 Hrs. (3/Week)
Summative Assessment Marks (C_3): 80 marks		**Exam. Duration:** 3 Hrs
Formative Assessment C_1 Test = 10 marks C_2 Test/Assignment/ Tour Report/Seminar = 10 marks		**Exam. Marks Total:** 80 + 20 = 100 Marks

Objectives of the Course	**Objectives; This paper enable the students to gain/understand/obtain/Learn the knowledge about** ➢ Gain comprehensive knowledge of the Earth's internal structure, including the core, mantle, and crust, and understand the significance of these components in geological processes. ➢ Understand the physical and chemical properties of soil, factors influencing soil formation, and methods to assess soil quality for sustainable agricultural and environmental management. ➢ Study the formation of landforms through natural forces like rivers, glaciers, wind, and ocean currents. Analyze the influence of erosion, weathering, and volcanic activities on landscape formation. ➢ Develop a foundational knowledge of the Earth's structure, geological processes, and their significance in shaping landforms and influencing environmental systems.
Course out come	**Course outcome: After studying this Course, the students are able to** 1. **Comprehensive Understanding of Earth's Structure and Processes:** Students will be able to describe the Earth's internal structure, identify key components of the lithosphere, and explain the significance of rocks, minerals, and elemental abundance in the Earth's crust. 2. **Analysis of Geological Phenomena and Landform Development:** Learners will analyze various geological processes, including tectonics, weathering, and erosion, and evaluate their role in shaping landforms and contributing to soil formation. 3. **Application of Soil Science Concepts:** Students will demonstrate knowledge of soil properties, including physical and chemical characteristics, and apply appropriate methods to assess soil health, fertility, and management. **Practical Application in Environmental Management:** By integrating concepts from geology and soil science, , students will propose sustainable solutions for soil erosion control, land degradation prevention, and environmental conservation

Unit No	**Course Content**	**Hours**
	Fundamentals of earth Science : scope and relevance of	

UNIT 1	environmental geology, A brief study on the interior of the earth. Structure and composition of lithosphere. **Minerals and rocks :** Minerals and important rock forming minerals; Classification of rocks- igneous, sedimentary and metamorphic rocks. rock cycle: **Land forms, Weathering and mass wasting** : Nature and types of land forms. Role of geological agents – river, wind and ocean. Soil, Formation of soil by mechanical, chemical & biotic weathering, factors affecting weathering. Soil profile and horizons. Classification of soil. Mass wasting-forms of mass wasting, factors affecting mass wasting.	16 Hrs.
UNIT 2	**Physical properties of soil :** Introduction, specific surface of soil particles, Soil texture, Soil structure- definition, formation and importance of soil structure. Types, classes and grades of soil. Soil color, importance of soil colors. Soil aeration- definition, causes, mechanism, factors affecting and importance of soil aeration. Soil temperature- Factors affecting soil temperature. **Heat Balance of Soil:** Concept, measurement, and its role in plant growth and microbial activity. Methods for soil temperature regulation in agricultural practices **Chemical Properties of soil:** Chemical composition of soil. Soil colloids, properties of soil colloids, ion exchange of soil- factors affecting cation and anion exchange capacity of soil. Soil solution, soil reaction pH, factors affecting soil reaction pH. Formation of acid soils, characteristics of acidic soils harmful for plant growth. Control measure of soil acidity. Characteristics and formation of saline and alkaline soil, effect of soil salinity & alkalinity on plant growth. Control measures of soil salinity**.**	16 Hrs.
UNIT 3	**Soil Erosion and Control:** Definition, Facets of Soil Erosion: Overview of physical, chemical, and biological aspects of soil erosion. Forms of Soil Erosion: Natural Erosion vs. Accelerated Erosion. Types: Sheet erosion, Rill erosion, Gully erosion, Stream bank erosion, and Wind erosion. Factors and Causes of Soil Erosion: Natural factors: Climate, soil type, topography, and vegetation cover. Anthropogenic factors: Deforestation, overgrazing, improper agricultural practices, and construction activities. **Corrective Measures of Erosion**: **Agronomic Practices**: Crop rotation, contour ploughing, strip cropping, and cover cropping. Mechanical Methods: Terracing, check dams, and retaining walls. Biological Methods: Afforestation, agroforestry, and grassland management. Soil Conservation Techniques: Mulching, reduced tillage, and use of bioengineering methods.	16 Hrs.

	Saltwater Intrusion and Coastal Erosion: Causes and impact of saltwater intrusion in coastal and groundwater systems. Coastal Erosion: Causes due to wave action, sea level rise, and human activities. Control Measures: Mangrove restoration, artificial reefs, beach nourishment, and seawalls.	

III SEMESTER PRACTICAL

Year - 2	**Course Code**	**LTP/Credits:** 0 0 4/2
Sem – III	**Paper Title: Environmental Geology and Soil Sciences**	**Total Teaching Hours:** 64 Hrs. (4/Week)
Summative Assessment Marks (C_3): 40 marks		**Exam. Duration:** 3 Hrs
Formative Assessment C_1 Test = 05 Marks C_2 Test/Assignment/ Tour Report/Seminar = 05 Marks		**Exam. Marks Total:** 40 + 10 = 50 Marks

1. Sampling techniques of soil
2. Study of the water holding capacity of different soils
3. Identification of Soil types,
4. Studies on the construction of textural diagram.
5. Determination of Soil Texture in the laboratory using triangular textural diagram soil.
6. Determination of specific gravity of soil samples
7. Soil Analysis – Major elements (like $Ca^{2+}$and Mg^{2+}).
8. Determination of particle density of soil
9. Computation hydrological parameter – Porosity and permeability etc.
10. Determination of PH of Soil Samples.
11. Determination of lime content of the soil.
12. Estimation of oxidisible organic matter in soil by (Walkley and Black Method)
13. Study of electrical conductivity of soil sample.
14. Visit to Mining process and exploration
15. Study of different rock types
16. Visit to Earth Science department of University of Mysore, MGM
17. Visit to Geology Exhibitions and Natural History Museum

Reference:	1. Michael, P. (1986). Ecological Methods for Field and Laboratory Investigations. 2. Tata Mc Graw-Hill Publishing Co. Ltd. 3. Rolan, R. G. (1973). Laboratory and Field Investigations in General Ecology. Macmillan Co. 4. Standard Method for Examination of Water and Wastewater. (2017). APHA –WEF. 5. Subrahmanyam, N. S. and Sambamurty, A. V. S. S. (2000). Ecology. NarosaPublishing House. 6. Trivedi, P. K. and Goel, P. K. (1984). Chemical and Biological Methods of WaterPollution Studies. Environmental Publications. 7. Environmental Science – Turk A. (1984) Saunders 8. Environmental Science –Eugen, E.d. (1983) W.C. Brown Co. 9. Man and Biosphere Today-Dusman R.S. (1974) Sterling Pub. Co. 10. Basic Ecology – E. Odum (1983) – Sunders 11. Concepts of Ecology – Kormondy 12. Introduction to Ecology-Colinvaux, P.A. (1973) John Wiley 13. Ecology of Tropical Oceans – Longhurst, A.R. and Daniel Pauly, Academic Press 14. Ecology of Inland waters and Estuaries – Reid, G.K. (1961), Reinhold Pub. 15. Practical Methods in Ecology and Environmental Science – Trivedi R.K. and others (1987) 16. Encyclopaedia of Environmental Science – Parker S.P. (1980) 17. Ecology- study of Ecosystems – Kisra K.C. and others – Wheeler and comp. Allahabad 18. New Approaches to Monitoring Aquatic Ecosystems –Boylo T.P. (1987) ASTM Philadelphia 19. Essentials of Ecologyand Environmental Science IVth edn. SVS Rana (2010)Eastern Economy Edition PHI 20. Ecology Principles and Application II nd EDn J.L Chapman and M.J. Reiss(2010)Cambridge University Press 21. Ecology 2nd edn: N.S. Subramanyam and A.V.S.S. Sambamurty (2008) Narosa publishing House. 22. Biological invasions: economic and environmental costs of alien plant, animal, and microbes. Pimentel ,.D (2011) CRC publication

<table>
<tr><td>Year - 2</td><td>Course Code SENOEC301</td><td>LTP/Credits: 3 0 0</td></tr>
<tr><td>Sem – III</td><td>Paper Title: OE1: ENVIRONMENT AND SUSTAINABLE AGRICULTURE</td><td>Total Teaching Hours: 48 Hrs. (3/Week)</td></tr>
<tr><td colspan="2">Summative Assessment Marks (C_3): 80 marks</td><td>Exam. Duration: 3 Hrs</td></tr>
<tr><td colspan="2">Formative Assessment
C_1 Test = 10 marks
C_2 Test/Assignment/ Tour Report/Seminar = 10 marks</td><td>Exam. Marks Total:
80 + 20 = 100 Marks</td></tr>
<tr><td>Objectives of the Course</td><td colspan="2">Objectives; This paper enable the students to gain/understand/obtain/Learn the knowledge about

➢ Gain comprehensive knowledge of the Earth's internal structure, including the core, mantle, and crust, and understand the significance of these components in geological processes.
➢ Understand the physical and chemical properties of soil, factors influencing soil formation, and methods to assess soil quality for sustainable agricultural and environmental management.
➢ Study the formation of landforms through natural forces like rivers, glaciers, wind, and ocean currents. Analyze the influence of erosion, weathering, and volcanic activities on landscape formation.
➢ Develop a foundational knowledge of the Earth’s structure, geological processes, and their significance in shaping landforms and influencing environmental systems.</td></tr>
<tr><td>Course out come</td><td colspan="2">Course outcome: After studying this Course, the students are able to

4. Comprehensive Understanding of Earth’s Structure and Processes: Students will be able to describe the Earth's internal structure, identify key components of the lithosphere, and explain the significance of rocks, minerals, and elemental abundance in the Earth's crust.
5. Analysis of Geological Phenomena and Landform Development: Learners will analyze various geological processes, including tectonics, weathering, and erosion, and evaluate their role in shaping landforms and contributing to soil formation.
6. Application of Soil Science Concepts: Students will demonstrate knowledge of soil properties, including physical and chemical characteristics, and apply appropriate methods to assess soil health, fertility, and management.

Practical Application in Environmental Management: By integrating concepts from geology and soil science, , students will propose sustainable solutions for soil erosion control, land degradation prevention, and environmental conservation</td></tr>
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Unit No	Course Content	Hours
UNIT 1	. Environment – Definition, scope and significance. Agriculture – Definition, scope and significance. Environmental basis for agriculture and food. Agricultural patterns in India. Socio-economic pressures on agriculture. Food security and food scarcity. Types of agriculture – rain-fed cultivation and irrigation – water intensive agriculture – Reservoirs and ground water exploitation. Conventional andmechanised agriculture. Natural and chemical agriculture. Subsistence and commercial agriculture. Environmental effects of land use and landscape changes.	16 Hrs.
UNIT 2	**Environmental determinants of agriculture** – role of rainfall, humidity, wind, topography and edaphic factors in crop selection. Animal husbandry – Dairy and poultry – role of transboundary species of cattle in Indian scenario. Pisiculture – Environmental effects of intensive pisiculture. Agricultural biodiversity: Crop diversity – Definition and significance. Poly culture and mono culture. Influences of green revolution on modern agricultural practices of India – Loss of agro biodiversity – Influence of transboundary crops. Agricultural biotechnology – Genetically Modified Crops – Influence on environment. Pollination crisis. Integrated pest management.	16 Hrs.
UNIT 3	**Environmental impacts of agriculture** – Loss of biodiversity – soil salinity – fertiliser and pesticide pollution, Climate change and global warming. Erosion and problems of deposition in irrigation systems. Desertification. Biomagnification – Case studies. Contemporary issues and management – Farmer distress – market mechanisms – natural farming methods/organic farming. Urban agriculture and hydroponics. Ecological principles of farming – Sustainable agriculture – Significance ofindigenous crops and cattle varieties. Watershed management. Agricultural policies of India.	16 Hrs.

References

Altieri, M. A. (2018). Agroecology: the science of sustainable agriculture. CRC Press.

Campanhola, C., & Pandey, S. (Eds.). (2018). Sustainable food and agriculture: An integrated approach. Academic Press.

de Zeeuw, H., & Drechsel, P. (Eds.). (2015). Cities and agriculture: Developing resilient urban food systems. Routledge.

Eric Lichtfouse, Mireille Navarrete, Philippe Debaeke, Souchere Ve´ronique, Caroline Alberola. (2009). Sustainable Agriculture. Springer Science & Business Media.

Kazim B. Rahim Debash Sarkar Bidhan Chand. (2012). Sustainable Agriculture and Environment. New Delhi Publishers.

Satyanarayana, T., Johri, B. N., & Prakash, A. (Eds.). (2012). Microorganisms in sustainable agriculture and biotechnology. Springer Science & Business Media.

Songstad, D. D., Hatfield, J. L., & Tomes, D. T. (Eds.). (2014). Convergence of food security, energy security and sustainable agriculture (Vol. 67). New York: Springer.

Year - 2	Course Code SENOEC302	LTP/Credits: 3 0 0
Sem – III	Paper Title: DSC GLOBAL WARMING AND ITS IMPACTS	Total Teaching Hours: 48 Hrs. (3/Week)
Summative Assessment Marks (C_3): 80 marks		Exam. Duration: 3 Hrs
Formative Assessment C_1 Test = 10 marks C_2 Test/Assignment/ Tour Report/Seminar = 10 marks		Exam. Marks Total: 80 + 20 = 100 Marks

Objectives of the Course	**Objectives; This paper enable the students to gain/understand/obtain/Learn the knowledge about** ➢ Gain comprehensive knowledge of the Earth's internal structure, including the core, mantle, and crust, and understand the significance of these components in geological processes. ➢ Understand the physical and chemical properties of soil, factors influencing soil formation, and methods to assess soil quality for sustainable agricultural and environmental management. ➢ Study the formation of landforms through natural forces like rivers, glaciers, wind, and ocean currents. Analyze the influence of erosion, weathering, and volcanic activities on landscape formation. ➢ Develop a foundational knowledge of the Earth's structure, geological processes, and their significance in shaping landforms and influencing environmental systems.
Course out come	**Course outcome: After studying this Course, the students are able to** 1. **Comprehensive Understanding of Earth's Structure and Processes:** Students will be able to describe the Earth's internal structure, identify key components of the lithosphere, and explain the significance of rocks, minerals, and elemental abundance in the Earth's crust. 2. **Analysis of Geological Phenomena and Landform Development:** Learners will analyze various geological processes, including tectonics, weathering, and erosion, and evaluate their role in shaping landforms and contributing to soil formation. 3. **Application of Soil Science Concepts:** Students will demonstrate knowledge of soil properties, including physical and chemical characteristics, and apply appropriate methods to assess soil health, fertility, and management. **Practical Application in Environmental Management:** By integrating concepts from geology and soil science, , students will propose sustainable solutions for soil erosion control, land degradation prevention, and environmental conservation

Unit No	Course Content	Hours
UNIT 1	Climate Change: Definition, scope and facts of climate change. Origin and evolution of the earth's atmosphere. Composition and thermal structure of atmosphere; Weather and climate; Meteorological parameters - temperature, pressure, precipitation, humidity, wind speed & direction. Introduction to the effects of various anthropogenic activities on earth's atmosphere. Monsoons – Definition, Indian monsoons – seasons: Cold weather	16 Hrs.

	season (Winter), the hot weather season (Summer), season of advancing monsoon (The rainy season) and season of retreating monsoon (The transition season). Cyclones of the Indian region; El-Nin˜o, La Nina and their impacts. Greenhouse effect and global warming: Definition, impacts, major greenhouse gases, sources and sinks of greenhouse gases; Urban Heat Islands; Ozone layer depletion and recovery, issues and remedies; ground level ozone and air pollution; global dimming. Carbon footprint.	
UNIT 2	Impacts of global climate change: Increased surface mean temperature, insect outbreaks, vector borne/zoonotic diseases, forest fire, reduced water availability, influence on agriculture, increase in floods and drought incidences, loss of biodiversity and extinction of species, sea level rise. Climate change and food security. Vulnerable populations – The Kiribati story. Climate change adaptation and mitigation: Definition, scope and objectives. Linkages between development, climate change impacts, their mitigation and adaptation. Clean Development Mechanisms; Green Climate Fund, The Adaptation Fund. United Nations Sustainable Development Goals. Role of individuals in achieving Sustainable Development Goals	16 Hrs.
UNIT 3	Climate change and policy frameworks – History of international climate change policies. United Nation Framework Convention on climate change (UNFCCC), The United Nations Conference on Environment and Development, Intergovernmental Panel on Climate Change (IPCC), Ministry of Environment, Forests & Climate Change (MoEF & CC), National Action Plan on Climate Change (NAPCC), Agenda 21, The Kyoto protocol, Paris agreement. Overview of Conference of Parties (CoP). Evolution of climate change negotiations. Carbon cycle feedback, Sea level rise and coastal impact, Climate change impact on biodiversity, Climate change and food production, Climate change and health impact, Sea level rise	16 Hrs.

References

Abhishek Tiwary and Jerem Colls. (2010). Air Pollution: Measurement, Modelling and Mitigation. III Edition, Routledge Publication.

Agarwal K.M, Sikdar P.K. and Deb S.C. (2002). A text book of Environment –MacMiller India Ltd., Calcutta

Climate Change: Science and Politics. (2021). Centre Science and Environment, New Delhi.

Donald Ahrens.C. (2008). Essentials of Meteorology: An Invitation to the Atmosphere. Cengage Learning publication.

Howard J. Critchfield. (1983). General Climatology (Fourth Edition), Phi Learning Pvt Ltd.

IPCC. (2006). Guidelines for National Greenhouse gas Inventories. Published by the Institute for Global Environmental Strategies (IGES), Hayama, Japan on behalf of the IPCC.

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John T. Hardy. (2003). Climate Change: Causes, Effects and Solution. John Wiley & Sons publications.

Mann, M. E. (2021). The New Climate War: the fight to take back our planet. Hachette UK.

Nicholas Stern. (2008). The Economics of Climate Change: The Stern Review. Cambridge University Press. Great Britain.

Rajit Sengupta and Kiran Pandey. (2021). State of India's Environment 2021: In Figures. Centre Science and Environment, New Delhi.

Roger G. Barry and Richard J. Chorley. (2007). Atmosphere, weather and Climate, 8th Edition, Routledge Publishers.

Romm, J. (2018). Climate Change: What Everyone Needs to Know®. Oxford University Press.

IV Semester Theory Syllabus

<table>
<tr><td>Year - 2</td><td>Course Code: SENDSC401</td><td>LTP/Credits: 300</td></tr>
<tr><td>Sem – IV</td><td>Paper Title: Environmental Chemistry</td><td>Total Teaching Hours:
48 Hrs. (3/Week)</td></tr>
<tr><td colspan="2">Summative Assessment Marks (C_3): 80 marks</td><td>Exam. Duration: 3 Hrs</td></tr>
<tr><td colspan="2">Formative Assessment
C_1 Test = 10 marks
C_2 Test/Assignment/ Tour Report/Seminar = 10 marks</td><td>Exam. Marks Total:
80 + 20 = 100 Marks</td></tr>
<tr><td>Objectives; of Course learning outcome:</td><td colspan="2">This paper enable the students to gain/understand/obtain/Learn the knowledge about

➢ Develop a comprehensive knowledge of the chemical processes in water, air, and soil that influence the environment.
➢ To study the physical, chemical, and biological characteristics of water and their significance in water quality assessment.
➢ Analyze the sources, types, and effects of air, water, soil, and radiation pollution on ecosystems and human health.
➢ To evaluate the health risks associated with radiation exposure and study the principles of radiation safety.
➢ To introduce students to the principles of chemical toxicology and the effects of toxic chemicals on human health and the environment.
➢ To encourage sustainable practices and contribute to environmental conservation efforts.</td></tr>
<tr><td>Course learning outcome:</td><td colspan="2">Course outcome: After studying this Course, the students are able to

COURSE OUTCOME

• Apply the fundamental concepts of environmental chemistry to understand the unique properties of water, its chemical reactions, and its role in maintaining ecological balance.
• Analyze and interpret the physico-chemical characteristics of water using standard parameters and evaluate water quality based on Indian Standard Specifications and WHO guidelines.
• Identify the sources, types, and effects of air, water, soil, and radiation pollution, and propose appropriate mitigation and management strategies to reduce environmental impact.
• Evaluate the toxic effects of metals, pesticides, and other chemicals on human health and the environment, understanding their mechanisms of toxicity and applying safety and control measures.

Develop practical problem-solving skills by applying scientific knowledge to address real-world environmental issues, contributing to sustainable environmental management and pollution control initiatives</td></tr>
<tr><td>Skills to be learned:</td><td colspan="2">The students will understand the sampling and analysis</td></tr>
<tr><td></td><td colspan="2"></td></tr>
</table>

Unit No	Course Content	Hours 48
UNIT 1	**Fundamentals of Environmental Chemistry** **Introduction to Environmental Chemistry:** Concept, scope, and significance in understanding environmental processes. **Water Chemistry:** Structure and properties of water molecules. Unique properties of water: Specific heat, latent heat, thermal conductivity, expansion, and freezing. **Chemical Reactions in Water:** Acid-base reactions and their environmental relevance. Redox reactions in natural water systems. Buffer systems and pH regulation in aquatic environments. **Physico-Chemical Characteristics of Water:** **Physical Parameters:** Colour, temperature, turbidity, taste and odour, conductivity. **Chemical Parameters:** pH, acidity, alkalinity, hardness, chlorides, fluorides, dissolved oxygen (DO). **Water demand Analysis:** Introduction to Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD).	16 Hrs.
UNIT 2	**Environmental Pollution:** Air pollution Definition, sources and types – gaseous pollutants and particulate matter; role and effects of oxides of nitrogen, sulphur, carbon and volatile organic compounds. Photochemical smog, greenhouse effect, acid rain, ozone depletion and their effect on flora and fauna. **Water and soil pollution :** Definition, sources and types of water pollution. Classification - organic, inorganic, biodegradable and non-biodegradable water pollutants. Eutrophication and their effect on flora and fauna. Soil pollution- sources, types and their impact on crops. **Radiation pollution:** Sources, types and properties of radiation. Interaction of radiation with matter, ionizing and non-ionizing radiation, impact of radioactive pollutant on plants and animals. Nature and classification of nuclear waste. General principles of nuclear waste disposal.	16 Hrs.
UNIT 3	**Chemical Toxicology: Concept**, scope, and significance of toxicology in the environment. Classification of toxic chemicals and their sources. Acute and chronic toxicity. **Toxic Effects on Human Health and Environment:** Carcinogens, teratogens, and mutagens — their characteristics and examples. **Metal Toxicity:** Sources, environmental fate, and bioaccumulation. Mechanisms of metal ion toxicity in living organisms. Detailed study of mercury, arsenic, copper, lead, cadmium, and chromium. **Cyanide Toxicity:** Environmental impact, Detoxification and management strategies.	16 Hrs.

	Pesticides - Definition, importance, and historical perspective.Concept of Integrated Pest Management (IPM). **Classification of Pesticides:** Insecticides, fungicides, herbicides, rodenticides, and nematicides. Examples and common uses. **Structural Features and Mode of Action:** Chemical structure and functional groups of common pesticides. Mechanism of action at the biochemical level. Persistence, bioaccumulation, and biomagnification. Bio-pesticides, microbial pesticides, and eco-friendly pest control methods.	

IV SEMESTER PRACTICAL

Year - 2	**Course Code:SENDSC402**	**LTP/Credits:** 004/2
Sem – IV	**Paper Title: Environmental Chemistry**	**Total Teaching Hours:** 64 Hrs. (4/Week)
Summative Assessment Marks (C_3): 40 marks		**Exam. Duration:** 3 Hrs
Formative Assessment C_1 Test = 05 Marks C_2 Test/Assignment/ Tour Report = 05 Marks		**Exam. Marks Total:** 40 + 10 = 50 Marks

1. Determination of pH of water from different sources.
2. Determination of temporary hardness.
3. Determination of calcium and magnesium.
4. Determination of acidity of water sample.
5. Determination of alkalinity of water sample.
6. Determination of chemical oxygen demand.
7. Estimation of chloride content in water.
8. Estimation of copper by iodometric method.
9. Measurement of turbidity of pond water using turbidometer.
10. Determination of Conductivity of water
11. Determination of phosphate by spectrophotometric method.
12. Estimation of lead by using xylenol orange indicator

Reference:	1. Environmental Chemistry by A.K. De, 2. Environmental Chemistry by Sharma & Kaur 3. Environmental Chemistry (III Edn) by Sodhi 4. Environmental Chemistry with Green Chemistry, Asim K. Das Books and Allied (P) Ltd. Kolkata, 2010 5. Radiation and Man-Jan H C National Book Trust, New Delhi 6. Gurjar,B.R., Molina, L.T. & Ojha C.S.P.2010. Air pollution: Health and Environmental Impacts. CRC Press, Taylor & Fraciis. 7. Pepper, I.L., Gerba , C.P & Brusseau , M.L, 2006. Environmental and

Pollution Science , Elsevier Academic Press.
8. Manhan.S.E 2000. Fundamentals of Environmental; chemistry. CRC publication.
9. Pani,B 2007. Textbook of Environmental chemistry. IK International Publishing House.
10. Connell,D.W.2005, Basic Concepts of Environmental Chemistry (3rd Edition) CRC Press
11. Hites,R.A.2012. Elements of Environmental Chemistry(2nd Edn) Wiley & Sons.
12. Girad,J.2013 .Principles of Environmental Chemistry (3rd Edn) Jones and Bartlet
13. Ajay Kumar Bhagiand Chatwal, G.R. Text book of Environmental Chemistry.Bhatia, S.C. 2011. Environmental Chemistry, CBS Publishers.
14. Day, A.K. 1984. Environmental Chemistry, Willey Eastern, III Ed.Faust, S.D. and Dly, O.M. 1983. Chemistry of water treatment.
15. Manahan, S.E. 2000. Environmental Chemistry, 7th Ed., Lewis Publications, Florida,U.S.A.
16. Sharma, B.K. and Kaur. 1995. Environmental Chemistry, Goel Publishing House,Meerut.
17. Sawyer, C.N., Mc Marty, P.L. and Perkin G.F. 1994. Chemistry for EnvironmentalEngineering, II Ed., Mc Graw Hill.
18. Tyagi, O.D. and Mehra, M. 1990. Environmental Chemistry, Anmol Publications
19. Baruah, T. C. and Barthakur, H. P. 1997. *Textbook of Soil Analysis*. Vikas PublishingHouse Pvt. Ltd.
20. Daji, J.A. 1988. *Textbook of Soil Science*. Media Promoters and Publishers. Firman, E. B. 1964. *Chemistry of Soils*. Oxford IBH Publishing Co.
21. Jackson, M. L. 1973. *Soil – Chemical Analysis*. Prentice Hall Publications.
22. Miller, R. W. and Donahue, R. L. 1992. *Soils – Introduction to Soils and PlantGrowth*. Prentice Hall of India.
23. Rowell, T. L. 1994. *Soil Sciences – Methods and Applications*. Longman Scientificand Technical.

Year - 2	**Course Code SENCP401** **(Compulsory and skill development)**	**LTP/Credits:** 00 2
Sem – IV	**Paper Title: Environmental , Social and Governance**	**Total Practical Hours:** 64Hrs. (4/Week)
Summative Assessment Marks ($C_{3)}$: 50 marks		**Exam. Duration:** 2.30 Hrs
Formative Assessment C_1 Test = 05 marks C_2 Test/Assignment/ Tour Report/Seminar = 05 marks C3 40 Marks :		**Exam. Marks Total:** 10+40=50

Objectives of the Course	**Objectives; This paper enable the students to gain/understand/obtain/Learn the knowledge about** ➢ Training and workshops: Hands-on training sessions on environmental topics, such as sustainable practices, conservation, and climate change. ➢ Mentorship: Pairing participants with experienced professionals in environmental fields for guidance and support. ➢ Practical projects: Assigning projects that apply theoretical knowledge to real-world environmental issues. ➢ Networking opportunities Facilitating connections with environmental professionals, organizations, and stakeholders.	
Course out come	Benefits ➢ Enhanced employability: Equipping participants with skills and knowledge to secure jobs in environmental sectors. ➢ Practical experience: Providing hands-on experience in environmental projects and initiatives. ➢ Networking: Building connections with professionals and organizations in the environmental field	
Unit No	**Course Content**	**Hours 64**
	Potential Topics: field Visit **1. Sustainable development in Environment** ➢ Implementing sustainable practices, such as waste reduction and energy efficiency. ➢ Studies on use biofertilizers and biopesticide ➢ Grey water recycling and reuse in house holds ➢ Community based watershed Management ➢ Urban composting using organic waste/ domestic waste ➢ Designing and building a small scale roof top rain water harvesting **2. Environmental Impact Assessment(procedure Writing)**	4 hrs X 16 practical's

	➢ Writing the EIA report – ➢ Environmental Water auditing, energy auditing ➢ Green auditing **3. Conservation biology visit to field** ➢ Conduct field survey in a nearby forest / sanctuaries/urban green area ➢ Studies on a Capitative breeding, ➢ Organising awareness drives in school and villages near wild life areas **4. Hands on Training; visit to laboratories** ➢ Water quality testing ➢ Physical and chemical parameters ➢ Soil testing	

Reference Books :

1. R.K.Jain and Sunil S.Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers , New Delhi (2006)

2. Slote.L,Handbook of Occupational Safety and Health, John Willey and Sons, New York .

3. Frank P Lees – Loss of prevention in Process Industries , Vol. 1 and 2, Butterworth- Heinemann Ltd., London (1991).

4. The Factories Act with amendments 1987, Govt. of India Publications DGFASLI, Mumbai

5. Grimaldi and Simonds , Safety Management, AITBS Publishers , New Delhi (2001)

6. Industrial Safety –National Safety Council of India

7. The Factories Act with amendments 1987, Govt. of India Publications DGFASLI, Mumbai Grimaldi and Simonds , Safety Management, AITBS Publishers , New Delhi (2001)

8. Industrial Safety –National Safety Council of India

Year - 2	**Course Code SENOEC402**	**LTP/Credits:** 3 0 0
Sem – IV	**Paper Title: OE: SENOE 402: ENVIRONMENTAL MANAGEMENT**	**Total Teaching Hours:** 48 Hrs. (3/Week)
Summative Assessment Marks (C_3): 80 marks		**Exam. Duration:** 3 Hrs
Formative Assessment C_1 Test = 10 marks C_2 Test/Assignment/ Tour Report/Seminar = 10 marks		**Exam. Marks Total:** 80 + 20 = 100 Marks

Objectives of the Course	**Objectives; This paper enable the students to gain/understand/obtain/Learn the knowledge about** • Define, categorize and explain hazards; • Health hazards associated with occupational health hazards and ergonomics; • Origin of fire, their detection and extinguishing methods; • First aid techniques for various casualties; • Selection and maintenance of personal protective equipment; • Management associated with occupational health and safety; • Various legislative measures associated with industrial safety
Course out come	• Students are able to apply the knowledge of occupational health and safety in industrial sector • Ability to provide industry with inputs on health and safety. • Able to learn about Fire and other Hazards and its implications. • Able to learn the first aid use and application. • Learn and disseminate issues related to occupational health and hazards. CO4 Protocol development for an industry on disaster prevention, health issues, safety measures and environment management.

Unit No	**Course Content**	**Hours**
UNIT 1	Environmental issues: Natural resource overuse and depletion, pollution,loss of biodiversity, Degradation of air, water and land. Water and wastewater management: Household water demand and uses. Availability of water for household uses. Centralised supply system – Rivers. Water treatment for portable purposes. Decentralised sources – Bore wells. Sustainable use of water – Reuse and recycling, rooftop rainwater harvesting. Grey water management – Septic tanks. Domestic solid waste management: Biodegradable – Kitchen waste - Issues and management. Compositing – Composters – Bin composter, three tier composters, pipe composting and mechanical composters. Human excreta - Issues and management. Bio-toilets, Dry/waterless toilets. Non- Biodegradable – Issues and management. Segregation – Dry, recyclables and sanitary wastes – Incinerators, pyrolysis and sanitary landfills	16 Hrs.

UNIT 2	Soil salinity, Eutrophication and Bio-magnification. Pesticide pollution - DDT and Endosulphan - Integrated Pest Management (IPM), Bio- pesticides, Genetic Modified Crops (GMCs). Natural farming methods. Irrigation and drainage systems (Israel Model), Hydroponics and Aeroponics. Alternative cultivation methods: Negative impacts of food grown by conventional agriculture methods. Minimizing fertiliser use and preventing chemical pesticide usage. Role of rooftop gardens and kitchen gardens in regulating microclimate. Biofertilisers – *Rhizobium*, *Azotobactor*, *Azospirilium*, Blue green algae, *Azolla*, Mycorrhizae. Livestock management: Dung and urine management – Biogas plants, Farm Yard Manure (FYM) and Vermi-composting. Human dwellings as micro climatic regimes: Variations in temperature and relative humidity in indoor and outdoor environment. Impacts of increased temperatures. Role of vegetation in micro climate regulation and Carbon capture. Green buildings and micro climate regulations.	16 Hrs.
UNIT 3	Environmental Management: Definition, Technologies need, significance and applications. Environmental Technology vs. Technology for Environment. Technological solutions for environmental degradation: Concept, advantages and limitations. Remedial actions - Waste recycling; Preventive actions - pollution prevention and Management actions - Environmental Management System (ISO 14000 series). Factors influencing transfer of Environmental technology - developer to technology user: Information, Research and Marketing. Factors influencing technology development: Localization, Customization and Contextualization. External factors influencing technology transfer: Laws and legislation; Administrative/Management systems; Information management; and Codes and Standards (*Eco-labelling and Green ratings*). Role of individuals in Environmental management: Resource measurements and monitoring, Ecological footprint analysis, Carbon footprint analysis, Water footprint analysis, Micro-climate monitoring and Participation in ecofriendly and sustainable endeavours.	16 Hrs.

References

Baskar, S., & Baskar, R. (2007). *Environmental Studies For Undergraduate Courses*. Unicorn Books.

Behera, B. K., & Prasad, R. (2020). *Environmental technology and sustainability: Physical, chemical and biological technologies for clean environmental management*. Elsevier.

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Kreith, F., & Tchobanoglous, G. (2002). *Handbook of solid waste management*. Mcgraw-hill.

Mitchell, B. (2013). *Resource and environmental management*. Routledge.

Nandini, N., Sunitha N., & Sucharita Tandon (2019). *A text book on EnvironmentalStudies (AECC)*. Sapna Book House, Bengaluru.

National Research Council. (1999). *Technologies for Environmental Management*, The Department of Energy's Office of Science and Technology.

Theodore, M. K., & Theodore, L. (2021). *Introduction to environmental management*. CRC Press.

Waite, R. (2013). *Household waste recycling*. Routledge.

Wong, J. W., Surampalli, R. Y., Zhang, T. C., Tyagi, R. D., & Selvam, A. (Eds.). (2016, January). *Sustainable solid waste management*. Reston, VA: American Society of Civil Engineers.

(MODEL QUESTION PAPER 1st to 4nd semester)
ENVIRONMENTAL SCIENCE AND OPEN ELECTIVES
(MAX MARKS: 100 (C_1:10 + C_2:10 + C_3:80)

Time: 3 hrs **Max. Marks: 80**

Note: 1. Answer all questions
Draw neat-labeled diagrams and give examples wherever necessary

SECTION A

Answer all the questions **10X 1 =10 marks**

1. Answer in one word or a sentence

a.
b.
c.
d.
e.
f.
g.
h.
i.
j.

SECTION B

Write short notes on any FIVE of the following: **5 X 6 = 30 Marks**

2.
3.
4.
5.
6.
7.
8.

SECTION C

Answer any FOUR of the following: **4 x 10 = 40 Marks**

9.
10.
11.
12.
13.
14.

University of Mysore
Yuvaraja's College (autonomous) Mysore

Scheme for Practical Examination for I to IV Semesters and CP papers

(MAX MARKS: 50 (C_1:05 + C_2:05 + C_3:40)

Time: **3hours**	**Max Marks: 40**
I. Major Experiment (Preparation, Identification/ Estimation/Quantification)	**20 Marks**
II. Writing a Comments	**10 Marks**
III. Record / project write up	**05 Marks**
IV. Viva voce examination	**05 Marks**

UNIVERSITY OF MYSORE

B.Sc., Degree Course

Environmental Science
(Three Year – Six Semester Scheme)
(III and IV Semester)

MODEL CURRICULUM (UNDER-GRADUATE) 2025-26
BACHELOR OF SCIENCE (B.Sc.) IN ENVIROMENTAL SCIENCE
SYLLABUS
(With New Regulations)

Environmental Science
B, Sc., III and IV Semester
(2025 - 26 on wards)
List of the Papers - Environmental Science

Papers	Core Course Discipline Specific Course (DSC)	Ability Enhanancement Compulsory Course (AECC)	Discipline Specific Elective (DSE)	Skill Enhanancement Course (SEC)	L	T	P	Total Credit
Third Semester ENVIRONMENTAL GEOLOGY AND SOIL SCIENCE								
SENDSC301	**ENVIRONMENTAL GEOLOGY AND SOIL SCIENCE**	-	-	-	**3**	-	-	**3**
SENDSC302	**PRACTICAL**	-	-	-	-	-	**4**	**2**
SENEC301			ENVIRONMENT AND SUSTAINABLE AGRICULTURE		**3**	-		**3**
SENEC302			GLOBAL WARMING AND ITS IMPACTS		**3**	-	-	**3**
IV Semester								
SENDSC401	**ENVIRONMENTAL CHEMISTRY**	-	-	-	**3**	-	-	**3**
SENDSC402	**PRACTICAL**	-	-	-	-	-	**4**	**2**
SENCP401				**Environmental Assessment and Monitoring**		-	**4**	**2**
SENEC402			**ENVIRONMENTAL MANAGEMENT**		-	-	-	**3**

The aims and Objectives of B.Sc. Environmental Science is to:

- Provide students with the scope to develop knowledge base covering all attributes of the environment and enable them to attain scientific/technological capabilities to find answers to the fundamental questions before the society with regards to human action and environmental effects with due diligence.

- Enhance the ability to apply this knowledge and proficiency to find solutions relating to environmental concerns of varied dimensions of present times

- Provide with a direction and technical capability to carry on lifelong learning and show teamwork and collaborative endeavour, and decision making

- Improve the employability of the graduates including the enhancement of self employment potential and entrepreneurial aptitude, and fill the technical resource gap especially in the Indian context

- Help graduates appreciate requirement of framing environmental policy guidelines

- Motivate graduates to appreciate that they are an integral stakeholder in the environmental management of India irrespective of their future jobs or working environments.

- Help graduates to understand the concerns related to Sustainable Development Goals (SDGs) and the Indian obligations

Program Learning Outcomes of B.Sc. Environmental Science is to :

- Ability to recognize the need for learning the topic and develop foundational knowledge on the topic.
- Ability to develop critical thinking and problem solving skills to solve interdisciplinary issues related to the topic.
- Ability to understand the relationships between natural and man-made systems
- Ability to apply technical methods and innovative techniques in classroom, field and laboratory to analyze scientific data
- Ability to develop lifelong learning and professional skills
- Ability to design and execute a scientific project, write scientific reports, develop research and communication skills
- Ability to spread awareness about the environment around us, sustainable development and conduct outreach activities
- Ability to gain empirical knowledge on the topic and contribute in decision making processes

MODEL CURRICULUM (UNDER-GRADUATE) 2024-25
DEGREE: BACHELOR OF SCIENCE (B.Sc.) IN ENVIROMENTAL SCIENCE
SYLLABUS
(With New Regulations)
III Semester Theory Syllabus

Year - 2	**Course Code**	**LTP/Credits:** 3 0 0
Sem – III	**Paper Title: ENVIRONMENTAL GEOLOGY AND SOIL SCIENCE**	**Total Teaching Hours:** 48 Hrs. (3/Week)
Summative Assessment Marks (C_3): 80 marks		**Exam. Duration:** 3 Hrs
Formative Assessment C_1 Test = 10 marks C_2 Test/Assignment/ Tour Report/Seminar = 10 marks		**Exam. Marks Total:** 80 + 20 = 100 Marks

Objectives of the Course	**Objectives; This paper enable the students to gain/understand/obtain/Learn the knowledge about** ➢ Gain comprehensive knowledge of the Earth's internal structure, including the core, mantle, and crust, and understand the significance of these components in geological processes. ➢ Understand the physical and chemical properties of soil, factors influencing soil formation, and methods to assess soil quality for sustainable agricultural and environmental management. ➢ Study the formation of landforms through natural forces like rivers, glaciers, wind, and ocean currents. Analyze the influence of erosion, weathering, and volcanic activities on landscape formation. ➢ Develop a foundational knowledge of the Earth's structure, geological processes, and their significance in shaping landforms and influencing environmental systems.
Course out come	**Course outcome: After studying this Course, the students are able to** 1. **Comprehensive Understanding of Earth's Structure and Processes:** Students will be able to describe the Earth's internal structure, identify key components of the lithosphere, and explain the significance of rocks, minerals, and elemental abundance in the Earth's crust. 2. **Analysis of Geological Phenomena and Landform Development:** Learners will analyze various geological processes, including tectonics, weathering, and erosion, and evaluate their role in shaping landforms and contributing to soil formation. 3. **Application of Soil Science Concepts:** Students will demonstrate knowledge of soil properties, including physical and chemical characteristics, and apply appropriate methods to assess soil health, fertility, and management. **Practical Application in Environmental Management:** By integrating concepts from geology and soil science, , students will propose sustainable solutions for soil erosion control, land degradation prevention, and environmental conservation

Unit No	**Course Content**	**Hours**
	Fundamentals of earth Science : scope and relevance of	

UNIT 1	environmental geology, A brief study on the interior of the earth. Structure and composition of lithosphere. **Minerals and rocks :** Minerals and important rock forming minerals; Classification of rocks- igneous, sedimentary and metamorphic rocks. rock cycle: **Land forms, Weathering and mass wasting** : Nature and types of land forms. Role of geological agents – river, wind and ocean. Soil, Formation of soil by mechanical, chemical & biotic weathering, factors affecting weathering. Soil profile and horizons. Classification of soil. Mass wasting-forms of mass wasting, factors affecting mass wasting.	16 Hrs.
UNIT 2	**Physical properties of soil :** Introduction, specific surface of soil particles, Soil texture, Soil structure- definition, formation and importance of soil structure. Types, classes and grades of soil. Soil color, importance of soil colors. Soil aeration- definition, causes, mechanism, factors affecting and importance of soil aeration. Soil temperature- Factors affecting soil temperature. **Heat Balance of Soil:** Concept, measurement, and its role in plant growth and microbial activity. Methods for soil temperature regulation in agricultural practices **Chemical Properties of soil:** Chemical composition of soil. Soil colloids, properties of soil colloids, ion exchange of soil- factors affecting cation and anion exchange capacity of soil. Soil solution, soil reaction pH, factors affecting soil reaction pH. Formation of acid soils, characteristics of acidic soils harmful for plant growth. Control measure of soil acidity. Characteristics and formation of saline and alkaline soil, effect of soil salinity & alkalinity on plant growth. Control measures of soil salinity**.**	16 Hrs.
UNIT 3	**Soil Erosion and Control:** Definition, Facets of Soil Erosion: Overview of physical, chemical, and biological aspects of soil erosion. Forms of Soil Erosion: Natural Erosion vs. Accelerated Erosion. Types: Sheet erosion, Rill erosion, Gully erosion, Stream bank erosion, and Wind erosion. Factors and Causes of Soil Erosion: Natural factors: Climate, soil type, topography, and vegetation cover. Anthropogenic factors: Deforestation, overgrazing, improper agricultural practices, and construction activities. **Corrective Measures of Erosion**: **Agronomic Practices**: Crop rotation, contour ploughing, strip cropping, and cover cropping. Mechanical Methods: Terracing, check dams, and retaining walls. Biological Methods: Afforestation, agroforestry, and grassland management. Soil Conservation Techniques: Mulching, reduced tillage, and use of bioengineering methods.	16 Hrs.

	Saltwater Intrusion and Coastal Erosion: Causes and impact of saltwater intrusion in coastal and groundwater systems. Coastal Erosion: Causes due to wave action, sea level rise, and human activities. Control Measures: Mangrove restoration, artificial reefs, beach nourishment, and seawalls.	

III SEMESTER PRACTICAL

Year - 2	**Course Code**	**LTP/Credits:** 0 0 4/2
Sem – III	**Paper Title: Environmental Geology and Soil Sciences**	**Total Teaching Hours:** 64 Hrs. (4/Week)
Summative Assessment Marks (C_3): 40 marks		**Exam. Duration:** 3 Hrs
Formative Assessment C_1 Test = 05 Marks C_2 Test/Assignment/ Tour Report/Seminar = 05 Marks		**Exam. Marks Total:** 40 + 10 = 50 Marks

1. Sampling techniques of soil
2. Study of the water holding capacity of different soils
3. Identification of Soil types,
4. Studies on the construction of textural diagram.
5. Determination of Soil Texture in the laboratory using triangular textural diagram soil.
6. Determination of specific gravity of soil samples
7. Soil Analysis – Major elements (like $Ca^{2+}$and Mg^{2+}).
8. Determination of particle density of soil
9. Computation hydrological parameter – Porosity and permeability etc.
10. Determination of PH of Soil Samples.
11. Determination of lime content of the soil.
12. Estimation of oxidisible organic matter in soil by (Walkley and Black Method)
13. Study of electrical conductivity of soil sample.
14. Visit to Mining process and exploration
15. Study of different rock types
16. Visit to Earth Science department of University of Mysore, MGM
17. Visit to Geology Exhibitions and Natural History Museum

Reference:	1. Michael, P. (1986). Ecological Methods for Field and Laboratory Investigations. 2. Tata Mc Graw-Hill Publishing Co. Ltd. 3. Rolan, R. G. (1973). Laboratory and Field Investigations in General Ecology. Macmillan Co. 4. Standard Method for Examination of Water and Wastewater. (2017). APHA –WEF. 5. Subrahmanyam, N. S. and Sambamurty, A. V. S. S. (2000). Ecology. NarosaPublishing House. 6. Trivedi, P. K. and Goel, P. K. (1984). Chemical and Biological Methods of WaterPollution Studies. Environmental Publications. 7. Environmental Science – Turk A. (1984) Saunders 8. Environmental Science –Eugen, E.d. (1983) W.C. Brown Co. 9. Man and Biosphere Today-Dusman R.S. (1974) Sterling Pub. Co. 10. Basic Ecology – E. Odum (1983) – Sunders 11. Concepts of Ecology – Kormondy 12. Introduction to Ecology-Colinvaux, P.A. (1973) John Wiley 13. Ecology of Tropical Oceans – Longhurst, A.R. and Daniel Pauly, Academic Press 14. Ecology of Inland waters and Estuaries – Reid, G.K. (1961), Reinhold Pub. 15. Practical Methods in Ecology and Environmental Science – Trivedi R.K. and others (1987) 16. Encyclopaedia of Environmental Science – Parker S.P. (1980) 17. Ecology- study of Ecosystems – Kisra K.C. and others – Wheeler and comp. Allahabad 18. New Approaches to Monitoring Aquatic Ecosystems –Boylo T.P. (1987) ASTM Philadelphia 19. Essentials of Ecologyand Environmental Science IVth edn. SVS Rana (2010)Eastern Economy Edition PHI 20. Ecology Principles and Application II nd EDn J.L Chapman and M.J. Reiss(2010)Cambridge University Press 21. Ecology 2nd edn: N.S. Subramanyam and A.V.S.S. Sambamurty (2008) Narosa publishing House. 22. Biological invasions: economic and environmental costs of alien plant, animal, and microbes. Pimentel ,.D (2011) CRC publication

<table>
<tr><td>Year - 2</td><td>Course Code SENOEC301</td><td>LTP/Credits: 3 0 0</td></tr>
<tr><td>Sem – III</td><td>Paper Title: OE1: ENVIRONMENT AND SUSTAINABLE AGRICULTURE</td><td>Total Teaching Hours: 48 Hrs. (3/Week)</td></tr>
<tr><td colspan="2">Summative Assessment Marks (C_3): 80 marks</td><td>Exam. Duration: 3 Hrs</td></tr>
<tr><td colspan="2">Formative Assessment
C_1 Test = 10 marks
C_2 Test/Assignment/ Tour Report/Seminar = 10 marks</td><td>Exam. Marks Total:
80 + 20 = 100 Marks</td></tr>
<tr><td>Objectives of the Course</td><td colspan="2">Objectives; This paper enable the students to gain/understand/obtain/Learn the knowledge about

➢ Gain comprehensive knowledge of the Earth's internal structure, including the core, mantle, and crust, and understand the significance of these components in geological processes.
➢ Understand the physical and chemical properties of soil, factors influencing soil formation, and methods to assess soil quality for sustainable agricultural and environmental management.
➢ Study the formation of landforms through natural forces like rivers, glaciers, wind, and ocean currents. Analyze the influence of erosion, weathering, and volcanic activities on landscape formation.
➢ Develop a foundational knowledge of the Earth’s structure, geological processes, and their significance in shaping landforms and influencing environmental systems.</td></tr>
<tr><td>Course out come</td><td colspan="2">Course outcome: After studying this Course, the students are able to

4. Comprehensive Understanding of Earth’s Structure and Processes: Students will be able to describe the Earth's internal structure, identify key components of the lithosphere, and explain the significance of rocks, minerals, and elemental abundance in the Earth's crust.
5. Analysis of Geological Phenomena and Landform Development: Learners will analyze various geological processes, including tectonics, weathering, and erosion, and evaluate their role in shaping landforms and contributing to soil formation.
6. Application of Soil Science Concepts: Students will demonstrate knowledge of soil properties, including physical and chemical characteristics, and apply appropriate methods to assess soil health, fertility, and management.

Practical Application in Environmental Management: By integrating concepts from geology and soil science, , students will propose sustainable solutions for soil erosion control, land degradation prevention, and environmental conservation</td></tr>
</table>

Unit No	Course Content	Hours
UNIT 1	. Environment – Definition, scope and significance. Agriculture – Definition, scope and significance. Environmental basis for agriculture and food. Agricultural patterns in India. Socio-economic pressures on agriculture. Food security and food scarcity. Types of agriculture – rain-fed cultivation and irrigation – water intensive agriculture – Reservoirs and ground water exploitation. Conventional andmechanised agriculture. Natural and chemical agriculture. Subsistence and commercial agriculture. Environmental effects of land use and landscape changes.	16 Hrs.
UNIT 2	**Environmental determinants of agriculture** – role of rainfall, humidity, wind, topography and edaphic factors in crop selection. Animal husbandry – Dairy and poultry – role of transboundary species of cattle in Indian scenario. Pisiculture – Environmental effects of intensive pisiculture. Agricultural biodiversity: Crop diversity – Definition and significance. Poly culture and mono culture. Influences of green revolution on modern agricultural practices of India – Loss of agro biodiversity – Influence of transboundary crops. Agricultural biotechnology – Genetically Modified Crops – Influence on environment. Pollination crisis. Integrated pest management.	16 Hrs.
UNIT 3	**Environmental impacts of agriculture** – Loss of biodiversity – soil salinity – fertiliser and pesticide pollution, Climate change and global warming. Erosion and problems of deposition in irrigation systems. Desertification. Biomagnification – Case studies. Contemporary issues and management – Farmer distress – market mechanisms – natural farming methods/organic farming. Urban agriculture and hydroponics. Ecological principles of farming – Sustainable agriculture – Significance ofindigenous crops and cattle varieties. Watershed management. Agricultural policies of India.	16 Hrs.

References

Altieri, M. A. (2018). Agroecology: the science of sustainable agriculture. CRC Press.

Campanhola, C., & Pandey, S. (Eds.). (2018). Sustainable food and agriculture: An integrated approach. Academic Press.

de Zeeuw, H., & Drechsel, P. (Eds.). (2015). Cities and agriculture: Developing resilient urban food systems. Routledge.

Eric Lichtfouse, Mireille Navarrete, Philippe Debaeke, Souchere Ve´ronique, Caroline Alberola. (2009). Sustainable Agriculture. Springer Science & Business Media.

Kazim B. Rahim Debash Sarkar Bidhan Chand. (2012). Sustainable Agriculture and Environment. New Delhi Publishers.

Satyanarayana, T., Johri, B. N., & Prakash, A. (Eds.). (2012). Microorganisms in sustainable agriculture and biotechnology. Springer Science & Business Media.

Songstad, D. D., Hatfield, J. L., & Tomes, D. T. (Eds.). (2014). Convergence of food security, energy security and sustainable agriculture (Vol. 67). New York: Springer.

Year - 2	Course Code SENOEC302	LTP/Credits: 3 0 0
Sem – III	Paper Title: DSC GLOBAL WARMING AND ITS IMPACTS	Total Teaching Hours: 48 Hrs. (3/Week)
Summative Assessment Marks (C_3): 80 marks		Exam. Duration: 3 Hrs
Formative Assessment C_1 Test = 10 marks C_2 Test/Assignment/ Tour Report/Seminar = 10 marks		Exam. Marks Total: 80 + 20 = 100 Marks

Objectives of the Course	**Objectives; This paper enable the students to gain/understand/obtain/Learn the knowledge about** ➢ Gain comprehensive knowledge of the Earth's internal structure, including the core, mantle, and crust, and understand the significance of these components in geological processes. ➢ Understand the physical and chemical properties of soil, factors influencing soil formation, and methods to assess soil quality for sustainable agricultural and environmental management. ➢ Study the formation of landforms through natural forces like rivers, glaciers, wind, and ocean currents. Analyze the influence of erosion, weathering, and volcanic activities on landscape formation. ➢ Develop a foundational knowledge of the Earth's structure, geological processes, and their significance in shaping landforms and influencing environmental systems.
Course out come	**Course outcome: After studying this Course, the students are able to** 1. **Comprehensive Understanding of Earth's Structure and Processes:** Students will be able to describe the Earth's internal structure, identify key components of the lithosphere, and explain the significance of rocks, minerals, and elemental abundance in the Earth's crust. 2. **Analysis of Geological Phenomena and Landform Development:** Learners will analyze various geological processes, including tectonics, weathering, and erosion, and evaluate their role in shaping landforms and contributing to soil formation. 3. **Application of Soil Science Concepts:** Students will demonstrate knowledge of soil properties, including physical and chemical characteristics, and apply appropriate methods to assess soil health, fertility, and management. **Practical Application in Environmental Management:** By integrating concepts from geology and soil science, , students will propose sustainable solutions for soil erosion control, land degradation prevention, and environmental conservation

Unit No	Course Content	Hours
UNIT 1	Climate Change: Definition, scope and facts of climate change. Origin and evolution of the earth's atmosphere. Composition and thermal structure of atmosphere; Weather and climate; Meteorological parameters - temperature, pressure, precipitation, humidity, wind speed & direction. Introduction to the effects of various anthropogenic activities on earth's atmosphere. Monsoons – Definition, Indian monsoons – seasons: Cold weather	16 Hrs.

	season (Winter), the hot weather season (Summer), season of advancing monsoon (The rainy season) and season of retreating monsoon (The transition season). Cyclones of the Indian region; El-Nin˜o, La Nina and their impacts. Greenhouse effect and global warming: Definition, impacts, major greenhouse gases, sources and sinks of greenhouse gases; Urban Heat Islands; Ozone layer depletion and recovery, issues and remedies; ground level ozone and air pollution; global dimming. Carbon footprint.	
UNIT 2	Impacts of global climate change: Increased surface mean temperature, insect outbreaks, vector borne/zoonotic diseases, forest fire, reduced water availability, influence on agriculture, increase in floods and drought incidences, loss of biodiversity and extinction of species, sea level rise. Climate change and food security. Vulnerable populations – The Kiribati story. Climate change adaptation and mitigation: Definition, scope and objectives. Linkages between development, climate change impacts, their mitigation and adaptation. Clean Development Mechanisms; Green Climate Fund, The Adaptation Fund. United Nations Sustainable Development Goals. Role of individuals in achieving Sustainable Development Goals	16 Hrs.
UNIT 3	Climate change and policy frameworks – History of international climate change policies. United Nation Framework Convention on climate change (UNFCCC), The United Nations Conference on Environment and Development, Intergovernmental Panel on Climate Change (IPCC), Ministry of Environment, Forests & Climate Change (MoEF & CC), National Action Plan on Climate Change (NAPCC), Agenda 21, The Kyoto protocol, Paris agreement. Overview of Conference of Parties (CoP). Evolution of climate change negotiations. Carbon cycle feedback, Sea level rise and coastal impact, Climate change impact on biodiversity, Climate change and food production, Climate change and health impact, Sea level rise	16 Hrs.

References

Abhishek Tiwary and Jerem Colls. (2010). Air Pollution: Measurement, Modelling and Mitigation. III Edition, Routledge Publication.

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Climate Change: Science and Politics. (2021). Centre Science and Environment, New Delhi.

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Howard J. Critchfield. (1983). General Climatology (Fourth Edition), Phi Learning Pvt Ltd.

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John T. Hardy. (2003). Climate Change: Causes, Effects and Solution. John Wiley & Sons publications.

Mann, M. E. (2021). The New Climate War: the fight to take back our planet. Hachette UK.

Nicholas Stern. (2008). The Economics of Climate Change: The Stern Review. Cambridge University Press. Great Britain.

Rajit Sengupta and Kiran Pandey. (2021). State of India's Environment 2021: In Figures. Centre Science and Environment, New Delhi.

Roger G. Barry and Richard J. Chorley. (2007). Atmosphere, weather and Climate, 8th Edition, Routledge Publishers.

Romm, J. (2018). Climate Change: What Everyone Needs to Know®. Oxford University Press.

IV Semester Theory Syllabus

<table>
<tr><td>Year - 2</td><td>Course Code: SENDSC401</td><td>LTP/Credits: 300</td></tr>
<tr><td>Sem – IV</td><td>Paper Title: Environmental Chemistry</td><td>Total Teaching Hours:
48 Hrs. (3/Week)</td></tr>
<tr><td colspan="2">Summative Assessment Marks (C_3): 80 marks</td><td>Exam. Duration: 3 Hrs</td></tr>
<tr><td colspan="2">Formative Assessment
C_1 Test = 10 marks
C_2 Test/Assignment/ Tour Report/Seminar = 10 marks</td><td>Exam. Marks Total:
80 + 20 = 100 Marks</td></tr>
<tr><td>Objectives; of Course learning outcome:</td><td colspan="2">This paper enable the students to gain/understand/obtain/Learn the knowledge about

➢ Develop a comprehensive knowledge of the chemical processes in water, air, and soil that influence the environment.
➢ To study the physical, chemical, and biological characteristics of water and their significance in water quality assessment.
➢ Analyze the sources, types, and effects of air, water, soil, and radiation pollution on ecosystems and human health.
➢ To evaluate the health risks associated with radiation exposure and study the principles of radiation safety.
➢ To introduce students to the principles of chemical toxicology and the effects of toxic chemicals on human health and the environment.
➢ To encourage sustainable practices and contribute to environmental conservation efforts.</td></tr>
<tr><td>Course learning outcome:</td><td colspan="2">Course outcome: After studying this Course, the students are able to

COURSE OUTCOME

• Apply the fundamental concepts of environmental chemistry to understand the unique properties of water, its chemical reactions, and its role in maintaining ecological balance.
• Analyze and interpret the physico-chemical characteristics of water using standard parameters and evaluate water quality based on Indian Standard Specifications and WHO guidelines.
• Identify the sources, types, and effects of air, water, soil, and radiation pollution, and propose appropriate mitigation and management strategies to reduce environmental impact.
• Evaluate the toxic effects of metals, pesticides, and other chemicals on human health and the environment, understanding their mechanisms of toxicity and applying safety and control measures.

Develop practical problem-solving skills by applying scientific knowledge to address real-world environmental issues, contributing to sustainable environmental management and pollution control initiatives</td></tr>
<tr><td>Skills to be learned:</td><td colspan="2">The students will understand the sampling and analysis</td></tr>
<tr><td></td><td colspan="2"></td></tr>
</table>

Unit No	Course Content	Hours 48
UNIT 1	**Fundamentals of Environmental Chemistry** **Introduction to Environmental Chemistry:** Concept, scope, and significance in understanding environmental processes. **Water Chemistry:** Structure and properties of water molecules. Unique properties of water: Specific heat, latent heat, thermal conductivity, expansion, and freezing. **Chemical Reactions in Water:** Acid-base reactions and their environmental relevance. Redox reactions in natural water systems. Buffer systems and pH regulation in aquatic environments. **Physico-Chemical Characteristics of Water:** **Physical Parameters:** Colour, temperature, turbidity, taste and odour, conductivity. **Chemical Parameters:** pH, acidity, alkalinity, hardness, chlorides, fluorides, dissolved oxygen (DO). **Water demand Analysis:** Introduction to Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD).	16 Hrs.
UNIT 2	**Environmental Pollution:** Air pollution Definition, sources and types – gaseous pollutants and particulate matter; role and effects of oxides of nitrogen, sulphur, carbon and volatile organic compounds. Photochemical smog, greenhouse effect, acid rain, ozone depletion and their effect on flora and fauna. **Water and soil pollution :** Definition, sources and types of water pollution. Classification - organic, inorganic, biodegradable and non-biodegradable water pollutants. Eutrophication and their effect on flora and fauna. Soil pollution- sources, types and their impact on crops. **Radiation pollution:** Sources, types and properties of radiation. Interaction of radiation with matter, ionizing and non-ionizing radiation, impact of radioactive pollutant on plants and animals. Nature and classification of nuclear waste. General principles of nuclear waste disposal.	16 Hrs.
UNIT 3	**Chemical Toxicology: Concept**, scope, and significance of toxicology in the environment. Classification of toxic chemicals and their sources. Acute and chronic toxicity. **Toxic Effects on Human Health and Environment:** Carcinogens, teratogens, and mutagens — their characteristics and examples. **Metal Toxicity:** Sources, environmental fate, and bioaccumulation. Mechanisms of metal ion toxicity in living organisms. Detailed study of mercury, arsenic, copper, lead, cadmium, and chromium. **Cyanide Toxicity:** Environmental impact, Detoxification and management strategies.	16 Hrs.

	Pesticides - Definition, importance, and historical perspective.Concept of Integrated Pest Management (IPM). **Classification of Pesticides:** Insecticides, fungicides, herbicides, rodenticides, and nematicides. Examples and common uses. **Structural Features and Mode of Action:** Chemical structure and functional groups of common pesticides. Mechanism of action at the biochemical level. Persistence, bioaccumulation, and biomagnification. Bio-pesticides, microbial pesticides, and eco-friendly pest control methods.	

IV SEMESTER PRACTICAL

Year - 2	**Course Code:SENDSC402**	**LTP/Credits:** 004/2
Sem – IV	**Paper Title: Environmental Chemistry**	**Total Teaching Hours:** 64 Hrs. (4/Week)
Summative Assessment Marks (C_3): 40 marks		**Exam. Duration:** 3 Hrs
Formative Assessment C_1 Test = 05 Marks C_2 Test/Assignment/ Tour Report = 05 Marks		**Exam. Marks Total:** 40 + 10 = 50 Marks

1. Determination of pH of water from different sources.
2. Determination of temporary hardness.
3. Determination of calcium and magnesium.
4. Determination of acidity of water sample.
5. Determination of alkalinity of water sample.
6. Determination of chemical oxygen demand.
7. Estimation of chloride content in water.
8. Estimation of copper by iodometric method.
9. Measurement of turbidity of pond water using turbidometer.
10. Determination of Conductivity of water
11. Determination of phosphate by spectrophotometric method.
12. Estimation of lead by using xylenol orange indicator

Reference:	1. Environmental Chemistry by A.K. De, 2. Environmental Chemistry by Sharma & Kaur 3. Environmental Chemistry (III Edn) by Sodhi 4. Environmental Chemistry with Green Chemistry, Asim K. Das Books and Allied (P) Ltd. Kolkata, 2010 5. Radiation and Man-Jan H C National Book Trust, New Delhi 6. Gurjar,B.R., Molina, L.T. & Ojha C.S.P.2010. Air pollution: Health and Environmental Impacts. CRC Press, Taylor & Fraciis. 7. Pepper, I.L., Gerba , C.P & Brusseau , M.L, 2006. Environmental and

Pollution Science , Elsevier Academic Press.
8. Manhan.S.E 2000. Fundamentals of Environmental; chemistry. CRC publication.
9. Pani,B 2007. Textbook of Environmental chemistry. IK International Publishing House.
10. Connell,D.W.2005, Basic Concepts of Environmental Chemistry (3rd Edition) CRC Press
11. Hites,R.A.2012. Elements of Environmental Chemistry(2nd Edn) Wiley & Sons.
12. Girad,J.2013 .Principles of Environmental Chemistry (3rd Edn) Jones and Bartlet
13. Ajay Kumar Bhagiand Chatwal, G.R. Text book of Environmental Chemistry.Bhatia, S.C. 2011. Environmental Chemistry, CBS Publishers.
14. Day, A.K. 1984. Environmental Chemistry, Willey Eastern, III Ed.Faust, S.D. and Dly, O.M. 1983. Chemistry of water treatment.
15. Manahan, S.E. 2000. Environmental Chemistry, 7th Ed., Lewis Publications, Florida,U.S.A.
16. Sharma, B.K. and Kaur. 1995. Environmental Chemistry, Goel Publishing House,Meerut.
17. Sawyer, C.N., Mc Marty, P.L. and Perkin G.F. 1994. Chemistry for EnvironmentalEngineering, II Ed., Mc Graw Hill.
18. Tyagi, O.D. and Mehra, M. 1990. Environmental Chemistry, Anmol Publications
19. Baruah, T. C. and Barthakur, H. P. 1997. *Textbook of Soil Analysis*. Vikas PublishingHouse Pvt. Ltd.
20. Daji, J.A. 1988. *Textbook of Soil Science*. Media Promoters and Publishers. Firman, E. B. 1964. *Chemistry of Soils*. Oxford IBH Publishing Co.
21. Jackson, M. L. 1973. *Soil – Chemical Analysis*. Prentice Hall Publications.
22. Miller, R. W. and Donahue, R. L. 1992. *Soils – Introduction to Soils and PlantGrowth*. Prentice Hall of India.
23. Rowell, T. L. 1994. *Soil Sciences – Methods and Applications*. Longman Scientificand Technical.

Year - 2	**Course Code SENCP401** **(Compulsory and skill development)**	**LTP/Credits:** 00 2
Sem – IV	**Paper Title: Environmental , Social and Governance**	**Total Practical Hours:** 64Hrs. (4/Week)
Summative Assessment Marks ($C_{3)}$: 50 marks		**Exam. Duration:** 2.30 Hrs
Formative Assessment C_1 Test = 05 marks C_2 Test/Assignment/ Tour Report/Seminar = 05 marks C3 40 Marks :		**Exam. Marks Total:** 10+40=50

Objectives of the Course	**Objectives; This paper enable the students to gain/understand/obtain/Learn the knowledge about** ➢ Training and workshops: Hands-on training sessions on environmental topics, such as sustainable practices, conservation, and climate change. ➢ Mentorship: Pairing participants with experienced professionals in environmental fields for guidance and support. ➢ Practical projects: Assigning projects that apply theoretical knowledge to real-world environmental issues. ➢ Networking opportunities Facilitating connections with environmental professionals, organizations, and stakeholders.	
Course out come	Benefits ➢ Enhanced employability: Equipping participants with skills and knowledge to secure jobs in environmental sectors. ➢ Practical experience: Providing hands-on experience in environmental projects and initiatives. ➢ Networking: Building connections with professionals and organizations in the environmental field	
Unit No	**Course Content**	**Hours 64**
	Potential Topics: field Visit **1. Sustainable development in Environment** ➢ Implementing sustainable practices, such as waste reduction and energy efficiency. ➢ Studies on use biofertilizers and biopesticide ➢ Grey water recycling and reuse in house holds ➢ Community based watershed Management ➢ Urban composting using organic waste/ domestic waste ➢ Designing and building a small scale roof top rain water harvesting **2. Environmental Impact Assessment(procedure Writing)**	4 hrs X 16 practical's

	➢ Writing the EIA report – ➢ Environmental Water auditing, energy auditing ➢ Green auditing **3. Conservation biology visit to field** ➢ Conduct field survey in a nearby forest / sanctuaries/urban green area ➢ Studies on a Capitative breeding, ➢ Organising awareness drives in school and villages near wild life areas **4. Hands on Training; visit to laboratories** ➢ Water quality testing ➢ Physical and chemical parameters ➢ Soil testing	

Reference Books :

1. R.K.Jain and Sunil S.Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers , New Delhi (2006)

2. Slote.L,Handbook of Occupational Safety and Health, John Willey and Sons, New York .

3. Frank P Lees – Loss of prevention in Process Industries , Vol. 1 and 2, Butterworth- Heinemann Ltd., London (1991).

4. The Factories Act with amendments 1987, Govt. of India Publications DGFASLI, Mumbai

5. Grimaldi and Simonds , Safety Management, AITBS Publishers , New Delhi (2001)

6. Industrial Safety –National Safety Council of India

7. The Factories Act with amendments 1987, Govt. of India Publications DGFASLI, Mumbai Grimaldi and Simonds , Safety Management, AITBS Publishers , New Delhi (2001)

8. Industrial Safety –National Safety Council of India

Year - 2	**Course Code SENOEC402**	**LTP/Credits:** 3 0 0
Sem – IV	**Paper Title: OE: SENOE 402: ENVIRONMENTAL MANAGEMENT**	**Total Teaching Hours:** 48 Hrs. (3/Week)
Summative Assessment Marks (C_3): 80 marks		**Exam. Duration:** 3 Hrs
Formative Assessment C_1 Test = 10 marks C_2 Test/Assignment/ Tour Report/Seminar = 10 marks		**Exam. Marks Total:** 80 + 20 = 100 Marks

Objectives of the Course	**Objectives; This paper enable the students to gain/understand/obtain/Learn the knowledge about** • Define, categorize and explain hazards; • Health hazards associated with occupational health hazards and ergonomics; • Origin of fire, their detection and extinguishing methods; • First aid techniques for various casualties; • Selection and maintenance of personal protective equipment; • Management associated with occupational health and safety; • Various legislative measures associated with industrial safety
Course out come	• Students are able to apply the knowledge of occupational health and safety in industrial sector • Ability to provide industry with inputs on health and safety. • Able to learn about Fire and other Hazards and its implications. • Able to learn the first aid use and application. • Learn and disseminate issues related to occupational health and hazards. CO4 Protocol development for an industry on disaster prevention, health issues, safety measures and environment management.

Unit No	**Course Content**	**Hours**
UNIT 1	Environmental issues: Natural resource overuse and depletion, pollution,loss of biodiversity, Degradation of air, water and land. Water and wastewater management: Household water demand and uses. Availability of water for household uses. Centralised supply system – Rivers. Water treatment for portable purposes. Decentralised sources – Bore wells. Sustainable use of water – Reuse and recycling, rooftop rainwater harvesting. Grey water management – Septic tanks. Domestic solid waste management: Biodegradable – Kitchen waste - Issues and management. Compositing – Composters – Bin composter, three tier composters, pipe composting and mechanical composters. Human excreta - Issues and management. Bio-toilets, Dry/waterless toilets. Non- Biodegradable – Issues and management. Segregation – Dry, recyclables and sanitary wastes – Incinerators, pyrolysis and sanitary landfills	16 Hrs.

UNIT 2	Soil salinity, Eutrophication and Bio-magnification. Pesticide pollution - DDT and Endosulphan - Integrated Pest Management (IPM), Bio- pesticides, Genetic Modified Crops (GMCs). Natural farming methods. Irrigation and drainage systems (Israel Model), Hydroponics and Aeroponics. Alternative cultivation methods: Negative impacts of food grown by conventional agriculture methods. Minimizing fertiliser use and preventing chemical pesticide usage. Role of rooftop gardens and kitchen gardens in regulating microclimate. Biofertilisers – *Rhizobium*, *Azotobactor*, *Azospirilium*, Blue green algae, *Azolla*, Mycorrhizae. Livestock management: Dung and urine management – Biogas plants, Farm Yard Manure (FYM) and Vermi-composting. Human dwellings as micro climatic regimes: Variations in temperature and relative humidity in indoor and outdoor environment. Impacts of increased temperatures. Role of vegetation in micro climate regulation and Carbon capture. Green buildings and micro climate regulations.	16 Hrs.
UNIT 3	Environmental Management: Definition, Technologies need, significance and applications. Environmental Technology vs. Technology for Environment. Technological solutions for environmental degradation: Concept, advantages and limitations. Remedial actions - Waste recycling; Preventive actions - pollution prevention and Management actions - Environmental Management System (ISO 14000 series). Factors influencing transfer of Environmental technology - developer to technology user: Information, Research and Marketing. Factors influencing technology development: Localization, Customization and Contextualization. External factors influencing technology transfer: Laws and legislation; Administrative/Management systems; Information management; and Codes and Standards (*Eco-labelling and Green ratings*). Role of individuals in Environmental management: Resource measurements and monitoring, Ecological footprint analysis, Carbon footprint analysis, Water footprint analysis, Micro-climate monitoring and Participation in ecofriendly and sustainable endeavours.	16 Hrs.

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Baskar, S., & Baskar, R. (2007). *Environmental Studies For Undergraduate Courses*. Unicorn Books.

Behera, B. K., & Prasad, R. (2020). *Environmental technology and sustainability: Physical, chemical and biological technologies for clean environmental management*. Elsevier.

Broniewicz, E. (Ed.). (2011). *Environmental management in practice*. BoD–Books on Demand.

Kreith, F., & Tchobanoglous, G. (2002). *Handbook of solid waste management*. Mcgraw-hill.

Mitchell, B. (2013). *Resource and environmental management*. Routledge.

Nandini, N., Sunitha N., & Sucharita Tandon (2019). *A text book on EnvironmentalStudies (AECC)*. Sapna Book House, Bengaluru.

National Research Council. (1999). *Technologies for Environmental Management*, The Department of Energy's Office of Science and Technology.

Theodore, M. K., & Theodore, L. (2021). *Introduction to environmental management*. CRC Press.

Waite, R. (2013). *Household waste recycling*. Routledge.

Wong, J. W., Surampalli, R. Y., Zhang, T. C., Tyagi, R. D., & Selvam, A. (Eds.). (2016, January). *Sustainable solid waste management*. Reston, VA: American Society of Civil Engineers.

(MODEL QUESTION PAPER 1st to 4nd semester)
ENVIRONMENTAL SCIENCE AND OPEN ELECTIVES
(MAX MARKS: 100 (C_1:10 + C_2:10 + C_3:80)

Time: 3 hrs **Max. Marks: 80**

Note: 1. Answer all questions
Draw neat-labeled diagrams and give examples wherever necessary

SECTION A

Answer all the questions **10X 1 =10 marks**

1. Answer in one word or a sentence

a.
b.
c.
d.
e.
f.
g.
h.
i.
j.

SECTION B

Write short notes on any FIVE of the following: **5 X 6 = 30 Marks**

2.
3.
4.
5.
6.
7.
8.

SECTION C

Answer any FOUR of the following: **4 x 10 = 40 Marks**

9.
10.
11.
12.
13.
14.

University of Mysore
Yuvaraja's College (autonomous) Mysore

Scheme for Practical Examination for I to IV Semesters and CP papers

(MAX MARKS: 50 (C_1:05 + C_2:05 + C_3:40)

Time: **3hours**	**Max Marks: 40**
I. Major Experiment (Preparation, Identification/ Estimation/Quantification)	**20 Marks**
II. Writing a Comments	**10 Marks**
III. Record / project write up	**05 Marks**
IV. Viva voce examination	**05 Marks**

Proceedings of the Annual BOS in Environmental Science (CB)

Ref: Univ. Notification No.UA2/379/2013-14 dated 05.05.2025

BOS in Environmental Science (CB) meeting was held on 19th May 2025at DOS in Environmental Science, Manasagangotri, Mysore-6.

Agenda for meeting:

1. Preparing of III and IV Semester Environmental Science syllabus for Under Graduate (UG)
2. Minor revision of existing M.Sc., Environmental Science syllabus
3. Scheme of Examination and panel of examiners for the academic year 2025-26 (PG and UG)

	Members Present		**Signature**
01	Prof. N.S.Raju,	Chairman	
02	Prof.G.V.Venkataramana,	Member	
03	Prof.K.Mantelingu	Member	
04	Prof. K. Yogendra	Member	
05	Dr. R.G.Sarathchandra	Member	
06	Prof. P.Brahmaji Rao	Member	Attended ONLINE
07.	Prof. Pravin U Meshram	Member	Attended ONLINE

In the beginning, Chairman, BOS in Environmental Science welcomed all the BOS members for the meeting. The committee members framed the curriculum for III & IV B.Sc., Environmental Science as per the credit pattern provided by the University of Mysore suggested Minor revision of existing M.Sc., Environmental Science syllabus. The committee approved Scheme of Examination and panel of examiners for the academic year 2025-26 (PG and UG).

Finally, Chairman thanked the all members at the end of the meeting.

19/5/25

(Dr N.S.Raju)
Professor & Chairman
BOS in Environmental Science

Professor & Chairman
DOS in Environmental Science
University of Mysore, Manasagangotri
Mysore-570 006, INDIA

ಮೈಸೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ

(ಳನೇ ಆವೃತ್ತಿಯ ನ್ಯಾಕ್ ಮರು ಮಾನ್ಯತೆಯಲ್ಲಿ 'ಎ' ಗ್ರೇಡ್ ಪಡೆದಿದೆ)

(ಎನ್.ಐ.ಆರ್.ಎಫ್.–2024 ರಾಜ್ಯ ಸಾರ್ವಜನಿಕ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ ವರ್ಗದಲ್ಲಿ 19ನೇ ಸ್ಥಾನ, ವಿಶ್ವವಿದ್ಯಾನಿಲಯ ವಿಭಾಗದಲ್ಲಿ 54ನೇ ಸ್ಥಾನ ಮತ್ತು ಒಟ್ಟಾರೆ ವರ್ಗದಲ್ಲಿ 86ನೇ ಸ್ಥಾನ)

ಪರಿಸರ ವಿಜ್ಞಾನ ಅಧ್ಯಯನ ವಿಭಾಗ, ಮಾನಸಗಂಗೋತ್ರಿ, ಮೈಸೂರು–06.

ಡಾ.ಎನ್. ಎಸ್. ರಾಜು
ಎಂ.ಎಸ್ಸಿ, ಎಂ.ಫಿಲ್. ಪಿಎಚ್‌ಡಿ
ಪ್ರಾಧ್ಯಾಪಕರು ಹಾಗೂ ಅಧ್ಯಕ್ಷರು

Phone: 0821-2419627
E-Mail: nsr@envsci.uni-mysore.ac.in
Mobile: 9448345959

ಸಂಖ್ಯೆ. ಎಂಜಿ/ಇಎಸ್/036 /2025 - 26 ದಿನಾಂಕ: 19.05.2025

ಗೆ,

ಉಪ ಕುಲಸಚಿವರು (Academic Section)
ಮೈಸೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ
ಮೈಸೂರು.

ಮಾನ್ಯರೆ,

ವಿಷಯ : ೨೦೨೫–೨೬ನೇ ಸಾಲಿನ ಅಧ್ಯಯನ ಮಂಡಳಿಯ ವಾರ್ಷಿಕ ಸಭೆಯ ನಡವಳಿಕೆಯನ್ನು ಕಳುಹಿಸಿಕೊಡುವ ಬಗ್ಗೆ.

ಉಲ್ಲೇಖ : ವಿಶ್ವವಿದ್ಯಾನಿಲಯದ ಪತ್ರದ ಸಂಖ್ಯೆ : ಯುಎ೨/೩೭೯/೨೦೧೩–೧೪ದಿನಾಂಕ ೦೫.೦೫.೨೦೨೫.

*****

ಮೇಲಿನ ವಿಷಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ, ನಮ್ಮ ವಿಭಾಗದಲ್ಲಿ ದಿನಾಂಕ ೧೯.೦೫.೨೦೨೫ ರಂದು ನೆಡದ ೨೦೨೫–೨೬ನೇ ಸಾಲಿನ ಅಧ್ಯಯನ ಮಂಡಳಿಯ ವಾರ್ಷಿಕ ಸಭೆಯ ನಡವಳಿಕೆಯನ್ನು ಈ ಪತ್ರದ ಜೊತೆ ಲಗತ್ತಿಸಿ ತಮ್ಮಲ್ಲಿಗೆ ಕಳುಹಿಸಿಕೊಡಲಾಗಿದೆ.

ವಂದನೆಗಳೊಡನೆ,

(ಡಾ.ಎನ್.ಎಸ್.ರಾಜು)
ಪ್ರಾಧ್ಯಾಪಕರು ಹಾಗೂ ಅಧ್ಯಕ್ಷರು
ಅಧ್ಯಯನ ಮಂಡಳಿ

Professor & Chairman
DOS in Environmental Science
University of Mysore, Manasagangotri
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University of Mysore, Manasagangotri
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UNIVERSITY OF MYSORE
DOS IN ENVIRONMENTAL SCIENCE
MANASAGANGOTRI, MYSORE-6

Choice Based Credit System of Syllabus
Master's Degree Programme in Environmental Science

I Semester

Sl. No.	Paper code	Title of the Paper	HC/SC/OE	L T P	Total Credits
1		Environmental Chemistry	HC-1	2 1 1	4
2		Environmental Geology	HC-2	2 1 1	4
3		Environmental Microbiology	HC-3	2 1 1	4
		Any two papers			
4		Green Technologies	SC-1	2 1 1	4
5		Environmental Statistics	SC-2	3 1 0	4
6		Environmental Planning and Sustainable development	SC-3	3 1 0	4

Total Credits 20

II Semester

No.	Paper code	Title of the Paper	HC/SC/OE	L T P	Total credits
1		Water and Wastewater Management	HC-4	2 1 1	4
2		Environmental Toxicology	HC-5	2 1 1	4
3		EIA, Environmental Policy and Laws	HC-6	3 1 0	4
		Any one of the papers			
4		Occupational Health and Safety	SC-4	3 1 0	4
&		**Or**			
5		Remote Sensing and GIS	SC-5	2 1 1	4
6		**Open Elective ***			4

Total Credits 20

III Semester

No.	Paper code	Title of the Paper	HC/SC/OE	L T P	Total credits
1		Environmental Biology	HC-7	2 1 1	4
2		Air, Noise and Radiation Pollution	HC-8	2 1 1	4
3		Disaster Management	HC-9	3 1 0	4
		Any one of the Papers			
4		Environmental Biotechnology	SC-6	2 1 1	4
		OR			
5		Climate Change and Current Issues	SC-7	3 1 0	4
6		**Open Elective ***			4

Total Credits 20

IV Semester

No.	Paper code	Title of the Paper	HC/SC/OE	L T P	Total credits
1		Conservation of Biodiversity	HC-10	2 1 1	4
2		Solid and Hazardous Waste Management	HC-11	2 1 1	4
3		Major Project work	HC-12	0 1 3	4
		Any one of the papers			
4		Natural Resources Management	SC-8	3 1 0	4
&		**OR**			
5		Marine Ecology and Coastal Pollution	SC-9	3 1 0	4
6		**Open Elective ***			4

Total Credits 20

Open Elective Papers*

Sl. No.	Paper Code	Title of the Paper	HC/SC/OE	L T P	Total Credits
1		Environment and Health	OE-1	3 1 0	4
2		Environmental Pollution and Management	OE-3	3 1 0	4
3		Nuclear & Bio Medical Waste Management	OE-5	3 1 0	4
4		Ecology & Environment	OE-6	3 1 0	4

*****

Courses will be offered in II, III & IV Semesters as will be decided in department council.

I*, II, III and IV Semesters:

Hard Core papers	-	48 Credits
Soft Core Papers	-	20 Credits
Open Elective Papers	-	12 Credits
	Total	80 Credits

*** There is no Open Elective Paper for first Semester**

I Semester

Hard Core Papers:

1. Environmental Chemistry:

Unit 1 – **Fundamentals of Environmental Chemistry:** Stoichiometry, Gibbs' energy, Chemical potential, chemical equilibria, acid-base reactions, solubility product, solubility of gases in water, the carbonate system, unsaturated and saturated hydrocarbons, radionuclide's.

Unit 2 – **Atmospheric chemistry:** Chemical composition of Air: Classification of elements, chemical speciation. Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matters. Thermo chemical and photochemical reactions in the atmosphere. CFC's, Oxygen and Ozone chemistry, chemistry of air pollutants, photochemical smog. Electrochemical theory of corrosion

Unit 3 - Chemical pollution and fundamentals of chemical reactions: Oxidation, reduction, precipitation. Toxic chemicals in the environment, biochemical aspects of Arsenic, Cadmium, Lead, Mercury CO, O_3, PAN, pesticides, MIC and carcinogens in air.

Unit 4. **Water chemistry:** Introduction of water chemistry, chemical parameters, types of reaction in various water bodies including marine environment. Chemistry of oil based and water based paint, physico-chemical basis of redox processes Electrochemical theory of corrosion.

Practicals :

1. Determination of pH and Conductivity of different water and soil samples
2. Determination of calcium and magnesium by EDTA complex metric method
3. Determination of total dissolved solids in water samples.
4. Determination of Carbonates and Bicarbonates in water samples
5. Estimation of Iodine value of given oil sample by C.A.T method
6. Determination of copper content in industrial effluents by Iodometric method
7. Determination of ferrous iron by permanganate method
8. Estimation the amount of phenol/ Aniline in the water sample by Bromate- Bromide method
9. Determination of Saponification value of given oil samples.
10. Determination of Natural and synthetic dyes.

References:

1. Analytical Chemistry of Industrial poisons, Hazards and solvents by Jacobs M.B. Inter Science. New York, (1969)
2. Environmental Chemistry, Sharma B.K. & Kaur, Goel Publishing House Meerut, (1995)
3. Chemistry for Environmental Engineering, Sawyer C.N, Mc Marty P.L. and Perkin G.F. Mc Graw Hill, (II ed) (1994)
4. Environmental Chemistry, Tyagi O.D. and Mehra M Anmol Publications, (1990)
5. Environmental Chemistry, Manahan S.E, Lewis Publications, Florida, U.S.A, (7^{th} ed),
6. Chemistry of the Environment, Bailey R.A. Academic Press, , (1970)
7. Vogel'sText book of quantitative Inorganic analysis Bernetts.J, Denney.R.C., Jeffery.J.H. and Mendham.J

2. Environmental Geology:

Unit 1 – Environmental Geology – objectives, scope and necessity, Origin of the Earth, Earth systems and its interaction with - lithosphere, atmosphere, hydrosphere and biosphere, Interior of the Earth, Earth's Materials – Minerals and their definition. Distribution and abundance of elements in the Earth's crust, Formation and classification of Rocks. Soil-characteristics, formation of soil, erosion and conservation.

Unit 2 – Earth's Processes – Endogenic and Exogamic Earth' s processes: Earthquakes, Tsunami and Volcanism. Geological agents: River, Wind, Glaciers and Ocean action. Floods, landslides, cyclone and avalanche, Concepts of major, trace and REE, Classification of trace elements, Mobility of trace elements, Geochemical cycles. Human use of trace elements and health.

Unit 3 – Mineral resources and environment. Resources and Reserves, Environmental uses of minerals and rocks, Depletion trends of natural resources, Environmental impact of Exploitation resources. Geological features of India and Karnataka.

Unit 4- Land use Planning, Topographical studies of different land surfaces Environmental aspects of terrain evolution, Methods of site selection and evaluation of land in environmental planning.

Practicals :

1. Identification of Minerals and Rocks.
    a) Physical properties & chemical composition of various rock forming minerals,
    b) Study of economic minerals
    c) Hand specimen study of Igneous, rocks.
    d) Hand specimen study of sedimentary rocks
    e) Hand specimen study of metamorphic rocks
2. Classification of soils and sediment
3. Classification texture & mineralogy
4. Interpretation of Topo sheets
5. Concept of land maps

References:

1. Earth Science and the Environment, Richard J.Ordway, D.Van Nostrand and Company, London.
2. Encounter with the Earth, L.F. Oxford press, San Francisco., Laporte,
3. Soil and water conservation Engineering, Schwab. S.O, Frevert.R.K, Edimster. T.W. and Barns, K.K., John Wiley and Sons, 1975.
4. Land Application of Wastes, Loehr, R.C.Jesel, W.J.Novak, N.D., Clarkson, W.S. and Friedeman G.S., Van Nostrand Reinhold Co., New. York., Vol-I and II, 1979
5. Environmental Geology, Valdia K.S., 1987
6. The nature of Oceanic life, Menard H.W., W.H.Freeman and Company, San Francisco, The Ocean – A Scientific American Book, (1969).
7. Essentials of Geology, Reed Wicander & James S. Monroe, Wadsworth publishing company, (2002).

3. Environmental Microbiology:

Unit – 1: Introduction**,** Concepts and scope of environmental microorganisms as components of ecosystem, characteristics and classification of Microorganisms, Microbial interactions. Micro organisms as bio-indicators in the environment, Role of microorganisms in bio-geo chemical cycle.

Unit 2: Microbial diversity of environment**:** Microbes in air, water and soil distribution, sampling techniques and identification. Microbes of extreme environment. , thermopiles acidophiles, alkaliphiles, halophiles, basophilesMechanisms and adaptation by microorganisms to environmental extremes and their survival.,

Unit 3:.Microbes for the degradation of pollutants Bioremediation- in-situ, ex-situ advantages and disadvantages. Control of pests and diseases by microorganisms, Biological Treatment of solid and liquid waste, microbial growth curves, microbial characteristic of water and wastewater.

Unit 4 : Microbial degradation of pesticides and heavy metals.. Microbes in metal extraction, mineral leaching and mining. Role of microbes in oil recovery, Ecological implication of genetically modified microorganisms, microbial plastics.

Practicals:

1. Serial dilution of soil and water
2. Preparation of different types of microbial culture media
3. Study of Gram staining techniques
4. Study of microorganisms in air
5. Isolation, enumeration and identification of microorganisms in soil samples
6. MPN Membrane filtration techniques for Coli form analysis
7. Determination of heavy metals on microbial growth
8. Determination of pesticide on soil microorganisms
9. Imvic test of Enteric bacteria (Indole Production, Methyl red, Voge-Proskauer Test and Citrate utilistion)
10. Effect of radiation on microbial growth
11. Effect of Chemicals on microbial growth
12. Isolation of helophilic and other exophilic organism
13. Isolation of DNA from environmental samples

References:

1. Environmental MicrobiologyPrinciples and Applications. Patrick K. Jemba.
2. Environmental Microbiology By. P D Sharma
3. Environmental bioremediation technologies. Shree N. Singh, Rudra D. Tripathi
4. Introduction to Microbiology. A. S. Rao
5. Microbiological examination of water and wastewater,Maria Csuros, Csaba Csuros.
6. Environmental Microbiology. Raina M. Maier, Ian L. Pepper, Charles P. Gerba - Science.
7. Text book of Environmental, Microbiology, Mohapatra - Technology & Engineering.

Soft Core Papers:

4. Green Technologies:

Unit 1 - Introduction – renewable energy sources, non-renewable energy sources, non-conventional and inexhaustible energy resources. Geothermal energy, wind driven power station, Tidal power plants, Glacier power plants, solar energy, nuclear energy, natural radio activity, nuclear power plant, fast breeder reactors, nuclear fusion, gobar gas

Unit 2 – Energy management – solar energy input, conventional fuels – oil, coal, natural gas, uranium, risk of nuclear accidents, bio energy – biomass and bio fuels, biogas- biogas technology, petro plants, energy plantations and crops. Waste as renewable sources of energy-types of wastes, classification based on chemical nature and physical state, composition of the waste, conversion of methane into synthetic gas, factors affecting methane formation. Second and Third generation biofuels, Geo thermal energy.

Unit 3 – Green Technology: Phyto-remediation- Hyperaccumulators- biotic interactions, biofilm, Green chemistry-introduction- inception and evolution- importance of solvents- types of catalysts and their role- Biological alternatives- applications. Principles of green chemistry, advances in green chemistry.

Unit 4- Green buildings, energy conservation in buildings, materials for green buildings waste management in buildings, essential components in Green building. Application in relation to Environment protection. Constriction of green building and green building laws

Practicals:

1. Study and identification of energy plants
2. Adsorption and removal of chromium and iron using different biomaterial
3. Study of biofuel /green chemistry / petroleum energy plants characteristics.
4. To study the working principles of wind plant/ nuclear energy plant / Gober gas plant/Glacier plant
5. Luxmeters- measurement of light intensity in indoor and outdoor environment.
6. Separation of organic/biopigments by TLC
7. Determination of surface tension, density and viscosity of oils
8. Determination of NTU in different samples using NTU meter
9. Visit to Wind mills.

References:

1. Rashmi Sanghi and Srivasta M.M., Green Chemistry, Narosa (2006)
2. Stanley E Manahan, Environmental Chemistry, Lewis Publications (2001)
3. Sharma, B.K. Kaur H., Environmental Chemsitry, Goel, publishing House (1995)
4. Tyagi O.D and Mehra M, Text book of Environmental Chemistry, Anmol publications (1990)

5. Environmental Statistics:

Unit 1-Sampling- Types of sampling, **Descriptive Statistics,** Descriptive vs. Inferential, Measures of location — mean, median, mode, Measures of dispersion — variance, standard deviation, range and interpercentile ranges Dispersion Percentages, Skewness, Concepts of outliers, **Correlation and regression**-Bi-variate data and scatter diagram, Simple (linear) correlation and regression, Coefficient of correlation and regression and their properties, Fitting of regression line, Multiple and partial correlations and regressions. **Graphs and Displays-** Introduction, z-Scores and Percentile Ranks, Stem and Leaf Displays,

Unit 2- Matrices and determinants- Types of matrices**,** addition and subtraction of matrices, Multiplication of a matrix by a scalar, Products of matrices, Evaluation of 2 × 2 determinants, Inverse of 2 × 2 matrices, Combinations of transformations, Eagan value, Applications of matrices in Environmental Impact assessment.

Unit 3- Probability- Introduction, Random Variables, Definition, Expected Value, and Standard Deviation, Probability Distributions, Binomial and Poisson Distributions, **Statistical hypothesis testing-**The basic approach, Alternative hypothesis, Examples of bad practice, **One sample tests in environmental science-** Z-test on a mean with known variance, T-test on a mean with unknown variance, Z-test for non-zero correlation, **Two sample tests-** T-test on unpaired means with unknown variance, T-test on paired means with unknown variance, F-test for equal variances, Z-test for unpaired equal correlations, Chi Square test, ANOVA,

Unit 4- Introduction to environmental system analysis; Approaches to development of models; linear simple and multiple regression models, validation and forecasting, Basics of coding, Computer applications in Environmental Sciences, point source stream pollution, model, box model, Gaussian plume model, General Circulation Model(GCM) for climatic change.

References

1. Fundamentals of Mathematical Statistics by S. C. Gupta and V. K. Kapoor; S. Chand & Co.
2. Statistical Methods in Geographical Studies, by Aslam Mahmood, Rajesh Publications, New Delhi
3. Statistical Methods: An Introductory Text by J. Medhi, New Age International Ltd. Publishers
4. Practical Statistics (Vol 1&2) by Singh, Atlantic Publishers
5. Environmental Statistics and data analysis, Ott, W. R., Lewis Publishers, New Jersey.
6. Statistical Methods, G. W. Snedecor & W. G. Cochran.
7. Statistics for environmental Biology and Toxicology, W. W. Piegorsh & A. J. Bailer.

6. Environmental Planning and Sustainable development:

Unit – 1 Environmental Planning – Perspective of environmental planning, land resources development planning, planning and managing the natural resources, Landscape ecological planning, information and decision of environmental planning, land use policies in India and world.

Unit – 2 Sustainable Development – scope and definition, parameters of sustainability, Population stabilization, integrated land use planning, healthy cropland and grassland, wood land revegetation, conservation of biological diversity, control of pollution, development of non-polluting renewable energy systems. Recycling of wastes/residues, ecologically compatible human settlement and slum improvement, environmental education and awareness, updating environmental law.

Unit – 3 Agriculture – sustainable agricultural rotation of crops, organic farming. Environmental degradation due to pesticides and chemical fertilizers - Sustainable Management, failure of green revolution, impact of modernization in agriculture and alternatives, participatory approach of modern agriculture.

Unit – 4: Urbanization and its impact on environment. Rural and urban planning for sustainable development, Urbanization impact on land resources. Environmental movements and role of NGO's in sustainable development. Global policy for sustainable development – world summits, SDG – 17.

References:

1. Eco-Efficiency: The Business link to Sustainable Development by Livio Desimone.
2. Planning Sustainability by Michael Kenny.
3. Environmentally Sustainable Economic Development by Asayehgn Desta.
4. **Environmental Science by S. C. Santra.**

II SEMESTER

Hard Core Papers:

1. Water and Wastewater Management:

UNIT-1 : Hydrology, Sources of water and its characteristics, Distribution of water on Earth. Physical and Chemical properties of Water, Various types of water demands, per capita demand water quality standards for various uses. Water Pollution, sources and types of Pollution, pollution scenario of Indian Rivers, water harvesting and watershed management.

UNIT – 2: Ground water Hydrology, Occurrence of groundwater, Ground water zones, and Groundwater System. porosity, permeability and types of Aquifers. The Water Table, ground water flow, functions and Topography, Ground water depletion, Ground water Quality, Ground water pollution, Saltwater Intrusion, Changes in Ground water Quality.

Unit 3 – Water purification - Screening – Treatment system, taste and odor removal (Aeration). , sedimentation, coagulation, filtration – rapid sand filter, slow sand filter, advantages and disadvantages. Disinfections – Methods of disinfections, water softening process.

Unit 4 : Wastewater treatment: Characteristics of wastewater, Screening & Grit chambers, sedimentation, secondary treatment – Aerated lagoons, Trickling Filters, Activated Sludge process, , screening batch reactors steriochemical treatment sludge disposal management UASB Aerobic and Anaerobic decomposition of wastewater, Tertiary treatment, sludge drying beds.

Practicals :

1. Determination of DO in water and wastewater samples
2. Determination of BOD in wastewater samples
3. Determination of COD water and wastewater samples
4. Determination of porosity and permeability of different soils.
5. Determination of infiltration and runoff characteristics.
6. Determination of Ammonia/nitrate content of water samples
7. Determination of phosphate content of water samples
8. Visit to water & wastewater treatment plants
9. Purification of sewage/wastewater

Reference :

1. Water and waste water Engineering, Vol.I and II, Fair, G.M. Geyer T.C. and Okun. D.A. (1984): John Wiley and Sons, Strauss, (1975) & (1984)
2. Waste water treatment processes, Metcalf and Eddy Inc. Academic Press, New York. (1979)
3. Standard Methods for Examination of Water and Waste Water American Public Health Association (5^{th} Ed) (1980)
4. Waste Water Engineering, Metcalf and Eddy Tata Mc Graw Hill,
5. Physico – Chemical Process for Water quality, Weber. W.J, Ann Arbor and company, New Delhi (1974)
6. Water and waste Engineering, Vol.I and II, Fair, G.M. Geyer T.C. and Okun. D.A. (1984): John Wiley and Sons, Strauss, (1975) & (1984)
7. Waste water treatment processes, Metcalf and Eddy Inc. Academic Press, New York. (1979)
8. Standard Methods for Examination of Water and Waste Water American Public Health Association (5^{th} Ed) (1980)
9. Waste Water Engineering, Metcalf and Eddy Tata Mc Graw Hill,
10. Physico – Chemical Process for Water quality, Weber. W.J, Ann Arbor.

2. Environmental Toxicology:

Unit – 1 : Introduction to toxicology, scope of toxicology subspecialties of toxicology, description and terminology of toxic effects, factors influencing toxicity, drug toxicity, biochemical basis of toxicity – mechanism of toxicity and receptor mediated events, acute and chronic toxicity, Selective toxicity. Dose response relationship-graded response time action curves, threshold limit value, LC_{50} LD_{50}, Margin of safety and toxicity curves.

Unit – 2 : Bioaccumulation and Biomagnifications of toxic materials in food chain, Toxicology of major pesticides-Environmental impacts of pesticides, biotransformation, biomonitoring, programs and parameters of biomonitoring, concept of bioindictor, bioindicator groups and examples. Basic concepts of Environmental forensics.

Unit – 3: Concepts of Bioassay- types, characteristics. Importance and significance of bioassay, Field based microbial bioassay for toxicity testing, particulate matter sources, and health impacts of specific particulate matter, chronic and acute effects of particulate matters on respiratory system mechanism of impact of particulate matters on cardio vascular system.

Unit - 4: Toxicology of Metal Plants samples, Dose response, Metal toxicology on fishes-case study. Effect of metals studies on hormones, Impact of metals on endocrine system of fishes.

Practicals :

1. Determination of solid food adulteration.
2. Methods of prevention of food poisoning.
3. Determination of liquid food adulteration.
4. Estimation of LC_{50} value in mosquito larvae.
5. Determine the histo toxicity/ histopathology of a given sample.
6. Spot test for the detection of nitrate/nitrite poisoning.
7. Determine the differential leukocyte count (DLC) of the pesticide treated blood smear.
8. Par fins sectioning and staining techniques
9. Determination of toxic chemicals in different samples.
10. Metal toxicology on fishes

Reference:

1. Environmental biology and Toxicology, by Sharma P.D. Rastogi and Lamporary., 1994.
2. Environmental pollution and Toxicology by Meera Asthana and Astana D.K., Alka printers, 1990.
3. Toxicology, by A.Sood, Sarup and sons New Delhi, 1999
4. Text book of Preventive and Social Medicine, by Park J.E. and Park K., Banosidas Bharat Publishers, Jabalpur, 1985
5. Environmental Epidemiology, by Anisa Basheer, Rawat Publication Jaipur, New Delhi 1995.
6. Toxicology, Biochemistry and Pathology of Mycotoxins, by Kenji Uroguchi a mikio, Yamazadi Kodanshoa Ltd., Tokyo, 1978.

3. EIA, Environmental Policy and Laws:

Unit 1 - Origin and development of EIA, Assessment and Prediction of impact on Air, water, noise and biological environments. Methods of impact analysis, EIA methodologies, public participation in Environmental decision making, Risk Assessment and mitigation measures, MOE-EIA notification, EIA case studies for infrastructure, development and industrial projects.

Unit – 2 Environmental Audit**:** General approaches to Environmental Auditing, Audit methods, benefits of environmental auditing. On-site and Post – Audit activities, statutory Environmental statements. Environmental Management System (EMS), ISO certification.

Unit 3 – Planning: Importance of planning, local, regional, state and national planning. Zoning-Physical planning. National policy, sectorial – integration, state level policy and implementation. Organizational structure at state and central government levels.

Unit 4 – Legal control of Environmental pollution in India with special reference to :

i. The Wildlife protection Act – 1972 and recent amendments
ii. The Water prevention and control of pollution Act, 1974, amended 1988: CESS Act 1977, amended in 1991.
iii. The Forest Conservation Act, 1980, amended in1988.
iv. The Air prevention and control of pollution Act, 1981, amended in 1990.
v. The Environment protection Act. 1986.
vi. Hazardous waste management rules-1989 & amendment rules
vii. Municipal waste management rules 2000 & amendment rules 2016
viii. Coastal Zone Regulation (CZR – 2018)

References

1. Defense preparedness in India – Jain N.K.,Joint assistance center, Adhyatma Sadhana Kendra Mehrauli, New Delhi
2. Environmental Law and Policy in India, Divan.S and Rosencranz. A, Oxford University Press, 2nd edition (2001)
3. Pollution control Legislation, Vol. I and II, Tamilnadu Pollution Control Board, Chennai (1999)
4. Environmental Chemistry by Sharma B.K. and Kaur, Goel Publishing House, Meerut (1995).
5. Law and Environment by Ahsok K Jain 2005
6. Environmental and pollution Laws cares and materials by C.S. Lall. 2003
7. Environment and pollution laws by S.K. Mohanty publication year 2013
8. Environment laws in India by satish c Shastri 2012
9. Environment Law by sumeet malik 2nd edition 2012
10. Sustainability by Patrick Dixon & Johan Gorecki 1st edition 2010
11. Environment Impact Assessment, A.K. Shrivastava, published by S.B. Nangia A.P.H publishing corporation New Delhi (2003)
12. Envi. Impact Assessment Methoddogies lay, Valli Manickan & M Aujaneyalu, B.S. Publication 2011.
13. Methods of Envi. Impact Assessment 3rd edition by petter moris & Riki Therivel. Taylor & Francis Groups 2009
14. Saiindia. Gov. in lenglish/home/our-product/Other Reports/Study. Report/Study. Report/Study. Report – Environment – Audit.

Soft Core Papers:

4. Occupational Health and Safety

Unit – **1** Occupational Environment- Physical, Chemical, Biological agents. Occupational hazards- Physical hazards, chemical hazards, Biological hazards. Occupational diseases- Pneumoconiosis- silicosis, Anthracosis, Byssinosis, Bagassosis, Astertosis, Farmers lung, Lead poisoning, Occupational cancer, Occupational Dermatitis, Radiation hazards.

Unit -2 Occupational hazards of agricultural workers- somatic diseases, accidents, toxic hazards, physical hazards, respiratory diseases, accidents in industry, sickness, absenteeism, health problems associate with different industries

Unit - 3 Measures for health protection of workers, preservation of occupational diseases- medical measures, engineering measures, Legislation- The factories Act, 1948. Human health problems due to pollution, public health programs, food poisoning- types of food poisoning prevention and control, indicators of health.

Unit-4: Fire safety and Equipment - Hospital Environment- sources', types, causes and control measures, of nosocomial infections, fire extinguishers, Fire alarm System, Automatic Fire detection. Fire protection tools in buildings, Industrial safety equipments.

References :

1. Fundamental principles of occupational health and safety. Benjamin O. Alli Handbook of Occupational Safety and Health, Louis J. Diberardinis,
2. Environmental Hazards: Assessing Risk and Reducing Disaster, Keith Smith, David N. Petley.
3. Physical and Biological Hazards of the work place, Peter H. Wald, Gregg M. Stave Proctor and Hughes.,
4. Chemical Hazards of the Workplace. Gloria J. Hathaway, Nick H. Proctor, James P. Hughes.,
5. Implementation of occupational health legislation at work place, issues and concerns. G. K. Kulakarni.,
6. Disaster Management future challenges and Opportunities by Jagbir Sing, I.K. International.

5. Remote Sensing and GIS :

Unit 1 - Fundamentals of Remote sensing: Remote Sensing – history & development, definition, concept and principles, Energy Resources, radiation principles, effect of radiation (isotopes exposers) Electromagnetic radiation, Interaction between matter and Electromagnetic radiation, Sensors: Types of sensors, Concept of Resolution – Spatial, Spectral, Temporal , Radiometric, Basic concepts and principles of Thermal , microwave and hyper spectral sensing, Spectral reflectance and their characteristics of Earth surface features, Satellites and their characteristics – Geo-stationary and sun-synchronous, Indian Space programme. Application of remote sensing in disaster and natural resource management.

Unit 2 - Platforms –Products used in Remote sensing, Images, scale, mosaics, time and seasons of orbital cycles. Aerial photographs, photographic systems, Satellite data products. Photogrammetry –- Basic principles, types, steps and elements of image interpretation, visual interpretation, interpretation equipments- digital image processing- image rectification, enhancement, classification,

Unit 3 - Introduction to GIS: GIS and their uses for Environmental monitoring, Remote Sensing Data Products and their procurement, GIS and spatial distribution of environmental data, Data integration and analysis, Data based structure, satellite data analysis, Data modules, concepts and types, basic concepts of GIS and its services.

Unit 4 - Data merging and biophysical modeling image processing software, GIS software. Remote sensing and GIS applications - Management and monitoring of Environment, conservation of resources, natural resources, coastal zone management.

Practicals :

1. Survey of a given area using Chain survey method
2. Survey of a given area using GPS survey method
3. Measurement of height difference by GPS method
4. Image interpretation of land use/water, vegetation and lithology
5. Study of geological /contour/drainage pattern maps
6. Assessment of pollution status of the given map
7. Photo interpretation.

Reference:

1. Environmental Radioactivity from Natural, Industrial and Miltry sources, Merril Eisenbud and Thomas Gessell Academic Press, London
2. Radiation and Man – Jain.H.C, National Book trust, New Delhi
3. Remote Sensing a better view – Rudd.R.D. (1974)
4. Remote sensing techniques for Environmental Analysis, Estes. J.E. and Senger.L.W
5. Remote sensing of Environment – Lintz.J and Simonnet.D.S (1976)
6. Remote Sensing and GIS for Environmental Planning – Murli Krishna.I.V.
    a. (1995).
7. Essential of Remote Sensing – (S.Srikantaswamy 2008)

III SEMESTER

Hard Core Papers:

1. Environmental Biology:

Unit 1- Ecosystems- Structure, functions, biotic and abiotic components, food chain, types of food chain, food web, Diversity Stability rule, Homeostasis. Ecological niche, spatial functional, Ecological Dominance. Energy flow in ecosystem, Lindeman model, Ecotone & Edge effect, Ecological Pyramids.

Unit 2 – Environmental factors- Limiting factors, climatic factors, influence of light on morphology and physiology of plants, characteristics of heliophytes and sciophytes, temperature – thermo periodicity, effect of low and high temperature on plants and animals. Atmospheric humidity-relative humidity in relation to metabolism of organism with suitable examples. Wind-mechanical effects of wind; lodging, breakage, deformation, anemophily and anemochory, physiological effects of wind. Edaphic factor-soil complex-soil erosion and soil conservation, fire factor, Plant indicators.

Unit 3 –Population ecology-Global and national scenario, Characteristics, population density, natality, mortality, age distribution, population growth, causes for population explosion, population control.

Unit 4- Biological interactions- Intraspecific and interspecific interactions, types of interspecific interaction- neutralism, positive interaction- negative interactions, both positive and negative interactions-Amensalism, mutualism, commensalism, parasitism and predation.

Practicals:

1. Study of binocular compound microscope/ Positive/ Negative staining of bacterial sample
2. Study of microbial flora/planktons found in water/soil samples including pond bottom sediments
3. Determination of Total alkalinity of different water samples
4. Estimation of chloride in the water samples
5. Determination of DO in water sample by modified Winkler's method
6. Estimation of Nygaard's algal indices in a given water sample
7. Identification of specimen/culture/materials of ecological interest.
8. Determination of Total Hardness of different water samples

References:

1. General Ecology– Kumar H.D et.al, Vikas publishing house Pvt.Ltd. New Delhi (1995)
2. Fundamental Ecology, Odum E.P.III Ed, Saunders, (1971)
3. Ecology – Culvinvux P, John Wiley and Sons, (1986)
4. Ecology and Environment – P.D.Sharma, Rastogi Publications, Meerut India
5. Ecology – Krebs J, II ed, Harper international
6. The Ecology of Tropical lakes and Rivers Payne A.I. John Wiley (1986)
7. Cell biology and evolution. P.S.Verma and Agarwal I ed. Chand

2. Air, Noise and Radiation Pollution:

Unit – 1 Air pollution; Natural and anthropogenic sources. Transport and dispersion of pollutants, Lapserate, meteorological conditions: Plume behavior, windrose Properties of air pollutants, Air quality: air quality monitoring- objectives, conventional monitoring, Non conventional approaches, sampling methods, gaseous sampling, stack monitoring, monitoring of particulates and smoke- Air quality standards.

Unit- 2 Air pollution effects on vegetation, animals and humans, Air pollution control measures, pollution rose, Indoor Air pollution: Sources-Indoor chemicals used, Checking the Indoor pollution, Indoor air quality. Odour pollution, preventive measures of odour pollution, Vehicular Pollution: Automobile emission- Types of emissions- Exhaust emissions, evaporative emissions, crank-case emissions. Prevention and control of automobile pollution.

Unit- 3 Noise. Source of noise, Reasons for Noise pollution, physical characteristics of sound waves: anatomy of sound, Theory of noise measurement – Sound pressure, loudness, sound intensity. Effects of noise pollution- Physico-chemical, social and psychological effects of noise, Prevention and control of noise pollution, Industrial noise control. Government rules to check noise pollution.

Unit-4 Radioactivity-Introduction, Disintegration types, units of radioactivity, interaction of radiation with matter, ionization, types of exposure, detection and measurement of radiation, Dosimeters, Biological effects of radiation. Stochastic and deterministic effects, Radiation protection, system of dose limitation, protection methodology.

Practicals:

1. Determination of SO_2 by PRA method
2. Determination NO_x by spectrophotometric method
3. Basic radioactive measurement procedures using GM counter
4. Studies on indicators of air pollution
5. Measurement of noise level in different environments by sound level meter (SLM)
6. Determination of particulate matters PM_{10} and $PM_{2.5}$ and TSPM
7. Determination of radiation in a given area using dosimeter
8. Determination of air pollutant toxicity by depletion of DTT assay
9. Determination of Air pollutant toxicity by depletion of antioxidant (Ascorbic acid)
10. Estimation of dose Accumulation on polluted and non polluted area (Plants)

References:

1. Environmental Chemistry by Sharma B.K & Kaur, Goel publishing House, Meerut (1995)
2. Environmental Science by Santra S.C., New Central Book agency, Pvt. Ltd., Kolkota
3. Chemistry for Environmental Engineering, Sawyer C.N, Mc Marty P.L. and Perkin G.F. Mc Graw Hill, (II ed) (1994)
4. Environmental Chemistry, Tyagi O.D. and Mehra M Anmol Publications, (1990)

3. Disaster Management:

Unit – 1 Environmental Disasters- Types of Hazards- Natural and Man made hazards- Nature of Hazards, Environmental security and Hazard zoning. Strategies of hazard mitigation. Concept of residence time and rates of natural cycles.

Unit – 2 Catastrophic- geological Hazards. Earthquake and seismic Hazards- effects of earthquake, stability of structures and risk evaluation, seismic topography. Prediction of earthquake, Volcanic Hazards- Nature of volcanic hazards, volcanic belt, prediction and mitigation of volcanic Hazards.

Unit 3 – Landslides and Mud flows- Types of mass movement, strength of materials and instability of slopes, controlling the landslides. Floods and flood management- causes of floods, management of floods. Floods control measures. Avalanches- Types of avalanches, monitoring of avalanches.

Unit 4 – Man made Disasters and Hazards- Improper Irrigation, deforestation, Industrial hazards- safety in industry. Management of dangerous materials in Industry, Safety system in industry. Disaster and accident prevention. Safety versus production, application of advanced techniques in disaster monitoring and assessment Disaster and its management- case studies. Disaster Management Act, 2005

References :

1. Industrial Hazards and Safety, Kind. R.W. and Magic J, Handbook, Butterworth (1982)
2. Introduction of Safety Science, Khulman A, TUV Rheinland, (1986)
3. Explosion Hazards & Evaluation, Barkey, W.E.Elsevier, Amsterdam (1983)
4. Management of Disasters and How to prevent them, Wharband O.P. and Stallworthy, E.A. (1986)
5. Disaster Management – Shailendera, K Singh, Subash. C Kundu and Shobu Singh, Mittal Publications, New Delhi (1998)
6. Disaster Management – Induprakash, Rasthra Prahari Prakashan, Gaziabad (1994).
7. Disaster Prepardness in India – Narendrakumar Jain, Adhytma Sadhan Kendra Mehrauli, New Delhi.

Soft Core Papers:

4. Environmental Biotechnology:

Unit – 1: Biotechnology and Biodiversity: conservation and utilization methods, their merits and demerits. Role of Biotechnology in energy production and management. Biosensors - Response of Biosensors, Types of biosensors, Application of Biosensors. Advantages of micro biosensors. Biochips – Biosurfactants,

Unit – 2: Biotechnological approaches for the degradation of petrochemical, tannery, industrial wastes, natural dyes, synthetic dyes, semisolid sludge, paper and distillery effluents. Technologies for environmental monitoring with special reference to prevention and detection. Concept of GMO's and genetic engineering approaches to waste treatment and environmental pollution management.

UNIT–3: Biotreatment of waste, Biofilters-types and applications. Bio fertilizer, importance and classification. Vermitechnology-vermicomposting and vermiculture. Role of biotic and abiotic factors in production of vermicompost. Organic farming and its applications. Microbial cellulolytic degradation of organic waste.

UNIT-4 Bio-pesticides, Introduction, Classification and applications, Integrated pest management, genesis of IPM concept, National and International prospective of IPM. Transgenic plants and animals, Phytoremediation, General process of phytoremediation and Phytodegdation types

Practicals :

1. Determination of anti oxidant capacity by phosphomolybdate method.
2. Study of biomass in polluted soil and water.
3. Determination of catalase activity in a water sample.
4. Study of cellulolytic degradation of organic waste.
5. Determination / Identification of Biofertilizers.
6. Determination of Natural/ Synthetic dyes.
7. Extraction of DNA from a tissue (mammalian liver/fish liver).
8. Extraction of RNA from plant/animal sours
9. Study of transgenic plants/animals/Biosensors/Biofertilizers/ Biochips.

Reference:

1. Text book of Environmental Biotechnology by Pradipta Kumar Mohapatra
2. Text book of Environmental Biotechnology by Indu Shekhar Thakur
3. Text book of Biotechnology by R.C. Dubey
4. Text book of Environmental Biotechnology by B.D.Singh
5. Text book of Environmental Chemistry by Ajay Kumar Bhagi & G.R.Chatwal
6. Text book of Microbiology by Pelzar

5. Climate Change and Current Issues:

Unit – 1 Global Environmental problems - Ozone depletion, causes and effects. Acid Rain Formation, adverse effects of acid rain. Photochemical smog, Factors responsible for photochemical smog, London Smog, Los Angeles Smog

Unit – 2 Green house gases – green house effect and climate change, Global warming Factors – Effects of Global warming – control and remedial measures of green house effect, global warming and climate change, impacts of sea level rise

Unit – 3 Man and Ecodegradation of Natural Environment, Present status of wasteland in India. Problems and prospects of wasteland development. Wasteland reclamation through Social Forestry, Bioaesthetic planting for pollution abatement impact of Climate Change on Natural Resources of in India

Unit– 4. Eutrophication and restoration of Lakes, Urban heat islands, Microclimate Environmental ethics - stewardship ethics and lifeboat ethics of Garret Hardin. Fly ash utilization, wet land conservation, Deforestation and its Impact National action plan on climate change IPCC and its role, Conventions on climate change and sustainable development.

References :

1. Environmental Education – Nanda. A.N. (1996)
2. A text book of Environment – Agarwal. K. M. Sikdar. P. K. and Deb. S. C, MacMiller India Ltd., Calcutta (2002)
3. Living in the Environment – Principles, Connections and Solutions – Tyler Miller Jr. G, Wadsworth Publishing Co. New York (1996)
4. Botkin, D.B.Changing the Global Environment, Academic Press, San Diago (1989)

IV SEMESTER

Hard Core Papers

1. Conservation of Biodiversity:

Unit - 1 Biodiversity – Genetic diversity, Species diversity and ecosystem diversity, alpha, beta, and Gamma diversity, values of Biodiversity – consumptive use value, optional values, productive use value, social value. Biowealth**,** endemism, significance of the endemism, Hot spots of Biodiversity,

Unit - 2 Brief account of endangered flora and fauna of India. Red data book and IUCN categories, endangered species, vulnerable species. Rare species. Man- Wildlife conflicts. Ecological consequences of reduction in biodiversity. Biodiversity issues – Deforestation and its impact. Two paradigms of Biodiversity, Convention on Biological diversity (CBD), Man and biosphere programme (MAB).

Unit -3 Causes for depletion of biodiversity in India, Biodiversity in Karnataka, conservation measures of biodiversity in Karnataka, Sacred grooves. Prospects and Perspectives of keystone species with special reference to Tiger.

Unit – 4 Biosphere Reserves – concept of conservation – objectives and management, Nilgiri Biosphere Reserve - Biosphere Reserves in India, *In situ* and *ex situ* conservation, Role of Zoos, National Parks and Sanctuaries in conservation, Biological Diversity Act of India

Practicals :

1. Determination of density of species using quadrant method
2. Determination of suitability point of a vegetation
3. Determination of frequency and relative frequency of species in a given area
4. Determination of abundance of species in a given area
5. Identification of endangered species of flora and fauna
6. Economic potentialities of selected plants and animals
7. Identification of ecological features of selected flora and fauna.
8. Study of adaptive features of hydrophytes
9. Study of adaptive features of xerophytes
10. Determination of Shannon-Weiner Index, Simpson Index, IVI.
11. Taxonomical conservation of animal specimen.

References :

1. Biodiversity – Strategies for Conservation – Dadhich.L.K. and A.P.Sharma, APH publishing corp. New Delhi, 2002
2. Global Biodiversity Conservation measures – Khan. T.I and Dhari. N Al-Ajmi, pointer publishers, Jaipur (1999)
3. An Advanced Text book on Biodiversity – Principles and Practice – Krishnamurthy. K.V, Oxford and IBH publishing, New Delhi (2003)

2. Solid and Hazardous Waste Management:

Unit 1 – Waste – Introduction, sources, characteristics, composition, classification, waste generated per capita- Global scenario. Solid Waste – collection, Storage, segregation-transportation and disposal methods-sanitary landfills and types, composting, anaerobic digestion, incineration, types of incineration, pyrolysis and medical waste, Biomedical waste Management.

Unit 2 – Hazardous waste-Introduction, characteristics, resource conservation and recovery act, listed hazardous waste, listing criteria. Classification of hazardous waste and handling of hazardous solid wastes, Radioactive wastes- sources, pollution, types of radioactive waste and its control and management.

Unit 3 – Waste management – waste minimization program, typical material recovery facility operation (TMRF), Reuse and recycling of paper, glass, rubber. Plastic wastes status in India, effect of plastic wastes on environment, management of plastic wastes.

Unit 4- Plastic waste (management and handling) ruies-2016, E-waste, Sources, classification and management rules 2016, fly ash management rules-1999, Waste auditing, concept of 3 R's, 4 R's & 5 R's biodegradable plastic, plastic, Biomedical waste management rules.

Practicals :

1. Characterization of solid waste from different sources.
2. Designing of secured/sanitary landfills.
3. To study of methods of management of biomedical waste.
4. Characterization of (TCLP) toxicity characteristic leaching test procedure hazardous waste from different sources.
5. Determination of organic carbon in compost/NPK in Compost.
6. Determination of inorganic phosphate in leachate samples.
7. Determination of kjeldhal nitrogen in leachate
8. Determination of TSS/TDS in leachate sample.
9. Field trip to municipal solid waste/zero waste management sites/ Biomedical waste plant.

References :

1. Hazardous Wastes and Solid Wastes- Lie, D.H.F. and Liptak, B.G. (2000), Lewis publishers, New York.
2. Solid Waste management in Developing countries – Indian National Scientific documentation center- Bhide and Sundaresan, New Delhi. (2000)
3. Solid waste management- George Tehobanaglous- Milary Theiren and Samuel A vigil, Integrated, Mc Graw Hill Inc, (1993).
4. WHO Manual on solid waste management
5. CPHEEO Manual on solid waste management
6. Hazardous Waste Management, II Ed, La Grega, M.D., Buckingham, P.L. and Evans J.C., Mc Graw Hill Inc., (2001)
7. Bioremediation, Baker, K.M. and Herson, B.S, Mc. Grqw-Hill Inc., (1994)

3.Major Project

Soft Core Papers:

4. Marine Ecology and Coastal Pollution:

Unit- 1 Marine ecology; Introduction to marine environment, marine bioresources and their economic importance, Marine Symbioses sources and causes for marine pollution, scope: effect of oil on marine environment, sea level rise and erosion, Tides and types of tides.

Unit- 2 Coastal pollution; Manmade pollution in coastal environment, Human impact on the Maine environmental coastal dumping, Status of biodiversity in coastal area, Brief account of benthic fauna, coral reefs and their economic importance.

Unit-3 Sustainable use and conservation of marine living resources, marine environmental protection, Marine protected Areas- benefits of MPA (MPA) Red tides and their significance, Sustainable development of small islands. Conventions related to marine and coastal environment.

Unit- 4 Coastal zone management – Specific issues: Habitation, Agricultural land, shrink area, industries, gas fields and sunder ban. Ecologically sound coastal zone management program wastewater discharge into marine environment and its impact near fields mixing far fields mixing

References:

1. Biodiversity – Strategies for Conservation – Dadhich.L.K. and A.P.Sharma, APH publishing corp. New Delhi, 2002
2. Global Biodiversity Conservation measures – Khan. T.I and Dhari. N Al-Ajmi, pointer publishers, Jaipur (1999)
3. An Advanced Text book on Biodiversity – Principles and Practice – Krishnmurthy. K.V, Oxford and IBH publishing, New Delhi (2003)
4. Coastal Environments V.Subramanian
5. Coastal Environment and water quality Y.Jon xu and Vijay P. Singh
6. Economic Analysis for Ecosystem – Applications to Marine and coastal Environments Daniel S.Holland, James N.Sanchirico Robert J.Jhonsson, Deepak, Joglekar
7. An Introduction to Marine Ecology, 3rd Edition R.S.K.Barnes, R.N.Hughes
8. Marine conservation Ecology Jonday, Mark Zachaias, John Roff
9. Oil Pollution and Marine Ecology Anthony Nelson- Smith

5. Natural resources management:

Unit 1:Introduction
Concept of resource, classification of natural resources- renewable and non renewable resources. Factors influencing resource availability, distribution and uses. Interrelationships among different types of natural resources. Ecological, Social and economic dimension of resource management Natural resources and development.

Unit: 2 Problems on resources
Food and energy resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies, Environmental effects of mining.

Unit: 3 Forest Resources
Vegetation type of India status and distribution Non Timber Forest Product (NTFP) uses, causes for depletion of forest resources. Timber extraction, Economical potential of forest products, effects of mining, dams on forest and tribal people.

Unit: 4 Wildlife management in India
Present scenario in India-present status of Tiger and Elephant population in India, Medicinal importance of Tiger pants, Management of conflicts between man and leopard, elephant. Priorities of wildlife conservation Ecotourism as a tool for wildlife conservation.

Reference:

1. Francois Ramade 1984, Ecology of Natural Resources. John Wiley and Sons Ltd.
2. Odum, E.P.1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
3. Cunningham, W.P Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publishing House.

Open Elective

1. Environment and Health

Unit-1 Environmental Health Problems: Health problems related to the environmental degradation, vulnerable groups in society. Environmental factors that can potentially affect health, environment and health indicators, major environmental and health issues, Specific pollutants or issues, indoor and outdoor environment Health problems, Human Bio monitoring.

Unit-2 Environmental Risks and the Disease Burden: Environmental risks and the disease burden in different regions of countries and in India, Environmental factors, the burden of disease in India. The health effects of air pollution. Health risks associated with agricultural and industrial pollution.

Unit-3 Environmental Health Risks, Assessment and intervention : Introduction, Determination of risk, Risk assessment, Risk assessment methods, Risk monitoring, Risk communication, protecting the public, Risk assessment in public health, Environmental impact studies.

Unit-4 Occupational hazards of agricultural workers, somatic disease, accidents, toxic hazards, physical hazards, respiratory diseases, accidents in industry, sickness, absenteeism, health problems due to industrialization.

References :

1. http://ec.europa.eu/environment/health/index en.htm
2. http://ec.europa.eu/environment/health/index en.htm
3. Biosafety and Bioethics by Sateesh M.K
4. Essentials of Environmental Health By Robert H Friis
5. Environmental health: ecological perspectives by Kathryn Hilgenkamp
6. Understanding Environmental Health: How We Live in the World by Nancy Irwin Maxwell,
7. Environmental Epidemiology: Principles and Methods by Ray M.Merrill,
8. Environmental Studies by Major Tiwari, Kapil Kulbe, Archana Tiwari, I.K.International.

2. Environmental Pollution and Management

Unit 1- Water and Thermal pollution- Introduction, types of water pollution, sources of water pollution, effects of water pollution, Primary, Secondary, Tertiary and Advanced treatments for control of water pollution, Thermal pollution- sources, harmful effects, prevention and control.

Unit 2- Classification of atmosphere, Air pollution- sources, classification, properties of air pollutants, effects of air pollution on plants and human beings, Control methods for industrial air pollution-fugitive emission and source emission. Automobile pollution and mitigation measures.

Unit 3- Soil pollution and Noise pollution- Soil pollution- sources, effects and control measures, noise pollution, sources, effects and control methods. Measurement of noise pollution.

Unit 4- Radiation and Bio pollution- Radiation pollution- types of radiations: non ionizing and ionizing, alpha, beta and gamma radiations, cosmic rays and X-rays, sources of radioactive pollution, impact of radiation pollution on human health, preventive measures, bio pollution- aeroallergens, pollen grains, fungi, bio pollutants as biological components.

References :

1. Environmental Chemistry by Sharma B.K. and Kaur, Goel Publishing House, Meerut (1995).
2. Environmental Biology and Toxicology by Sharma P.D. Rastogi and Lamporary 1994.
3. Environmental pollution and Toxicology by Meera Asthana and Astana D.K., Alka printers, 1990.
4. Environmental Science by S.C.Santra New central Book agency (Private) Limited Kolkata.
5. Ecology and Environment by P.D.Sharma, Rostogi Publications Meerut.
6. A Text book of microbiology by R.C.Dubey and W.K.Maheshwari S.Chand and Co. New Delhi.
7. Environmental Geology valdia. K.S Tata Mac Graw Publishers
8. Soil and water conservation Engineering – Schwab, S.G.et al John Wiley and sons 1975.
9. Soil Resources & the Environment – U. Aswathanarayana, oxford & IBH publishing, New Delhi.

3. Nuclear and Biomedical Waste Management

Unit – 1 Nuclear wastes – composition, Decay, scenario of nuclear wastes in the soil, nuclear fuel cycle, Nuclear energy, Management techniques-simple and high level nuclear waste management – Geological disposal. National & International management plans.

Unit – 2 Introduction, quality of hospital waste, sources of biomedical waste, classification and sources, pathological wastes, sharp pharmaceutical wastes, Genetonic wastes, Chemical wastes, waste contaminated with heavy metals.

Unit – 3 Measures to reduce biomedical wastes, Treatment of hazardous biomedical wastes, Biomedical waste management in developed countries and in India – legal aspects.

Unit – 4 E-waste, composition, sources. E-waste management in global and national scenario, Recycling and disposal strategies.

References :

1. Radiation and Man – Jain H.C. National Book Trust, New Delhi
2. Environmental Radioactivity from Natural, Industrial and Military sources, Merril Eisenbud and Thomas Gessell Academic Press, London.
3. Hazardous wastes and solid wastes / Lie DHF and Liptak B.G (2000), Lewis Publishers, New York
4. Hazardous waste Management, II Ed, La Grega M.D., Buckingham P.L. and Evan J.C MC Graw Hill Int. (2001)

4. Ecology and Environment

Unit – 1 Fundamentals of Ecology- Definition, principles, and scope of ecology, objectives and sub-divisions. Concept of levels of organization, Ecological Dominance, Population ecology. Characteristics, population density, natality, mortality, age distribution, population growth, causes for population explosion, population control.

Unit – 2 Ecosystems- Structure, functions, biotic and abiotic component, food chain, food web, Homeostasis, Ecological Niche, Ecological Dominance. Types of ecosystems : aquatic and terrestrial ecosystem.

Unit – 3 Resources of environment – Habitat- classification – reasons for depletion of natural resources – conservation of natural resources; air, water, soil, minerals, forests & wildlife.

Unit – 4 Ecological Adaptation; ecological adaptation of hydrophytes, ecological adaptation of mesophytes, ecological adaptation of xerophytes, ecological adaptation of halophytes. Deep sea adaptation, osmoregulatory adaptation

References :

1. Fundamentals of Ecology 3rd Ed. W.B.Saunders & Co.Philadelphia
2. Systems Analysis & Simulation in Ecology PattenB.C. (Ed) 1971 Academic press London
3. An Introduction to Cybemetics Chapman & Hall Ltd. Ashby W.R. 1956
4. Ecology & Environment seventh edition P.D.Sharma Rastogi publication Rajsons Printers, New Delhi (2004)
5. Plants and the Eco-system Macmilian & Co.Laondon Billings W.D 1964
6. Population Ecology A Unified study of Animals & Plants Blackwell Oxford, Begon M and Mortimer. M 1981
7. Environmental Concerns and strategies Indian Environmental Society Khoshoo T.N. 1984
8. Ecology with special Reference to Animals and Man Prentice- Hall New Jersey, Kendeigh S.C. 1974

Scheme of Examination

I/II/III/IV Semester M. Sc. Examination, ..MONTH …YEAR
(Scheme CBCS)
Environmental Science
Paper title:

Duration: 3 Hrs **Max Marks: 70**

Instruction: ***Answer all the three Parts.***

PART – A

Answer all the questions: **10 X 2 = 20**

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

PART – B

Answer any FIVE questions of the following: **5 X 4 = 20**

11.
12.
13.
14.
15.
16.
17.

PART – C

Answer any THREE questions of the following: **3 X 10 = 30**

18.
19.
20.
21.

UNIVERSITY OF MYSORE
DOS IN ENVIRONMENTAL SCIENCE
MANASAGANGOTRI, MYSORE-6.

Scheme of Examination

I/II/III/IV Semester M. Sc. Examination, ..MONTH …YEAR
(Scheme CBCS)
Environmental Science

Practicals

Duration : 3 Hrs **Max. Marks : 70**

Q.1. Conduct given Experiment, Write a procedure and calculate the results. 20 Marks

Q.2. Conduct the given experiment, write procedure and calculate the result 15 Marks

Q.3. Identify and Critical comment on. (Specimens / Spotters) 3 X 5 =15Marks

A.

B.

C.

Q. 4. Viva-Voce 10 Marks

Q.5. Class records 10 Marks

IV Semester M.Sc. Examination Project work (Dissertation) 70 Marks

Dissertation Thesis - 50 Marks
Viva-Voce - 20 Marks