SYLLABUS
AND
RULES AND REGULATIONS
FOR
TWO YEARS P.G. DEGREE COURSE
M. Sc. (ENVIRONMENTAL SCIENCES)

DEPARTMENT OF INTERDISCIPLINARY STUDIES
SCHOOL OF ENVIRONMENT SCIENCE
INSTITUTE OF INTEGRATED HIMALAYAN STUDIES
(UGC Centre of Excellence)
Himachal Pradesh University
Summer Hill, Shimla – 171005
RULES AND REGULATIONS

Introduction: The M.Sc. (Environmental Sciences) programme is relevant to young students/professionals who are looking to develop their analytical and research skills regarding important issues in environment. The course has been designed to meet the demand of growing needs of professionals in the fields of environment management, environment laws, environment governance and policy, impact assessment, natural resource management, pollution control, etc.

Nomenclature of the Course: The course is termed as M. Sc. (Environmental Sciences)

Time Frame: This course is of two years duration and is being run on semester basis. The course comprises Four Semesters. There are four theory papers and four practical/field study in first three semesters and three courses and dissertation in the fourth semester besides, class seminars, field visit, project reports and viva-voce etc. Teaching of this course was started from July, 2013.

Criteria for Admission and Age Limit: Normal entry requirement is a Bachelor Degree under 10+2+3 pattern of education in Sciences (Medical and Non-Medical), MBBS/B.V. Sc. or its equivalent from any Institute/University recognized by the HPU, Shimla / UGC, New Delhi with at least 50 percent (45 percent in case of SC/ST) marks in aggregate will be eligible for admission to this course. The Maximum age limit for the course is 26 years for boys and 28 years for the girl students on 1st July of the year concerned. In case of schedule caste/tribe the upper age limit will be raised by three years (for boys and girls) provided that, the Vice-Chancellor, HPU/ President IIHS shall have the power to permit the age relaxation for the reason to be recorded in writing up to a maximum of Six months.

However, the reservation of seats and the age limit for non-subsidized seats will be followed as applicable in other departments/institute like MBA, MTA etc. of the university.

The admission to this course is on the basis of the entrance examination. This exam basically tests the scientific attitude of the students. A brief description and knowledge based on the environment is tested to find out whether the candidate is really interested in the subject. The entrance test consists of 100 multiple-choice questions.

Career Opportunities

- Government and Business Sector (Environmental Manager, Environmental Planner, Environment Consultant, Analysts)
- Universities, Colleges and Research Institutes (Teaching and Research)
- Non-governmental Organizations at National and International Levels
Tentative Modalities and Requirements for the Course:

Eligibility for enrolment: Bachelor Degree under 10+2+3 pattern of education in Sciences (Medical and Non-Medical), MBBS/B.V. Sc. or its equivalent.

Duration of Programme: Two years

Medium of Instruction: English

Programme Structure: Total number of courses will be 27; There are four theory papers and four practical / field study in first three semesters and three courses and dissertation in the fourth semester besides, class seminars, field visit, project reports and viva-voce etc.

Mode of instruction: Semester System

Expected annual enrolment: 30+ One Supernumerary seat for Single Girl Child

Exposure Visit/ Field Visit/field study: Field study is carried out in each semester in the areas having environmental significance (Zoological park/botanical Park/ Hydropower project site/ industrial visit for studying the Effluent water treatment plant/ natural hazards site/ Solid waste water treatment plant/ Pollution Control Board, etc.) as decided by the department. The students are required to submit a report after the field visit. The students will also be taken for exposure visit to the sites of environmental importance.

Dissertation After the completion of third semester the students opt for special paper in the fourth semester. The students are equally distributed among the faculty members for supervision of the dissertation. The students are be given the topic for the field study/ experimental study to be completed and submitted by the end of forth semester as dissertation.

INTERNAL ASSESSMENT MARKS

Internal assessment for theory papers is assessed through the by the faculty on the basis of the class tests, seminars, and attendance of the student. Each student is given topic to make a power-point presentation during the class seminar, which is conducted every Saturday. In addition to this, there are class test of each subject which is mandatory for all the students.
### OUTLINE OF THE COURSE

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<tr>
<th>COURSE NO</th>
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<tr>
<td>MES-101</td>
<td>Environmental Geology and Atmospheric Science</td>
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<tr>
<td>MES-102</td>
<td>Environmental Biology</td>
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<tr>
<td>MES-103</td>
<td>Environmental Disasters: Mitigation and Management</td>
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<tr>
<td>MES-104</td>
<td>Current Environmental Issues and their Management</td>
<td>60</td>
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<tr>
<td>MES-105</td>
<td>Practical I (MES 101)</td>
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<td>Practical II (MES 102)</td>
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<td>MES-108</td>
<td>Field Study (MES 104)</td>
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Note: MES 101 to MES 104 will be of 100 marks (Theory-60, Internal Assessment-20 marks and MES–105-MES-108 Practical-20 marks)

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<td>MES-201</td>
<td>Environmental Pollution</td>
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<td>MES-202</td>
<td>Natural Resources: Conservation and Management</td>
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<td>MES-203</td>
<td>Ecotoxicology and Radiation Impacts</td>
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<td>MES-204</td>
<td>Environment Impact Assessment</td>
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Note: MES 201 to MES 204 will be of 100 marks (Theory-60, Internal Assessment-20 marks and MES–205-MES-208 Practical-20 marks)

*Field visit/ exposure visit including extended educational tours/ excursion visit as Industrial exposure/ Industrial visit be mandatory in each semester as per the requirement of the course curriculum.*
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<td>MES-301</td>
<td>Remote Sensing and GIS</td>
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<td>MES-302</td>
<td>Environmental Chemistry and Green Technology</td>
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<td>MES-303</td>
<td>Research Methodology, Statistics and Computer Applications</td>
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<td>MES-304</td>
<td>Techniques in Environmental Monitoring and Analysis</td>
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Note: MES 301 to MES 304 will be of 100 marks (Theory-60, Internal Assessment-20 marks and MES-305-MES-308 Practical-20 marks)

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<td>MES-401</td>
<td>Environmental Law, Governance, Ethics And Policy (Compulsory paper)</td>
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<td>MES-402 (i)</td>
<td>Special Paper I: Biodiversity and Wildlife Ecology (Optional paper)</td>
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<td>MES-402 (ii)</td>
<td>Special Paper II: Environment Economics (Optional paper)</td>
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<td>MES-402 (iii)</td>
<td>Special Paper III: Environmental Health (Optional paper)</td>
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<td>MES-402 (v)</td>
<td>Climate Change and Clean Technology (Optional paper)</td>
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<td>MES-402 (vi)</td>
<td>Environmental Clearance and Environmental Audit (Optional paper)</td>
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<td>MES-402 (vii)</td>
<td>Principles of Climatology (Optional paper)</td>
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<td>MES-403</td>
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GRAND TOTAL (First to fourth semester) **1500**

Note: MES 401 and 402 will be of 100 marks (Theory-80, Internal Assessment-20 marks). The students are required to opt one optional paper from MES-402 (i)- MES-402 (vii)
## SEMESTER – I

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Note: MES 101 to 104 will be of 100 marks (Theory-60, Internal Assessment-20 marks)
MES–105 to MES-108 Practical-20 marks
MES-101: ENVIRONMENTAL GEOLOGY AND ATMOSPHERIC SCIENCE

MODULE-1 ENVIRONMENT and ENVIRONMENTAL GEO-SCIENCE
1.1 Definition, evolution, characteristics principles and history of Environment and environmental Sciences.
1.2 Fundamental concepts, Primary differentiation and formation of core, mantle, crust, magma generation, dynamics of earth, Plate tectonics – sea floor spreading, mountain formation, Continental drift theory, Earth’s Magnetic field, types of seismic waves and their role in the study of earth’s interior.

MODULE-2 GEOMORPHOLOGICAL PROCESSES
2.1 Formations and classification of rocks rock cycle, Fold, and Fault, Major types of fold and faults,
2.2 Weathering and their types, Mass wasting and its types Volcanism , types, volcanic materials , process and effects of volcanism
2.3 Soil profile, soil classification, soils of India.

MODULE-3 ENVIRONMENTAL GEOCHEMISTRY
3.1 Concept of major, minor and trace elements. Mobility of elements, geochemical cycles.
3.2 Geo-indicators. Resources and reserves, Mineral resources and reserves.
3.3 Oceans as new areas for exploration of mineral resources. Mineral resources of Himachal Pradesh

MODULE-4 ATMOSPHERE
4.1 Different layers and their characteristics; meteorological aspects- inversions, mixing height, wind-rose, electromagnetic radiations, solar radiation and terrestrial radiation
4.2 Heat budget, Temperature measurements and controls, Environmental lapse rate, humidity, mixing ratio, dry and wet adiabatic lapse rate, clouds-types and their characteristics and atmospheric stability.
4.3 Atmospheric transport, diffusion and dispersion.

MODULE-5 WEATHER AND CLIMATE
5.1 Elements of Weather and Climate, classification, energy balance in atmosphere, greenhouse effect, Atmospheric general circulation,
5.2 Precipitation and types of storms, Indian monsoon, El Nino , La Nina effect, and western disturbances, Geostrophic wind and gradient wind, cyclones
5.3 Atmospheric moisture: Forms of cloud condensation; Precipitation, Thunderstorms, floods and droughts.
5.4 Global Climate variability and climate change. Introduction to Weather forecasting models.

SUGGESTED READINGS

NOTE FOR PAPER SETTER: The question paper will contain TWO QUESTIONS from each unit (Total TEN questions in all) and the candidate will be required to answer ONE QUESTION from each unit (total questions to be attempted will be FIVE) i.e. there will be internal choice within each unit.
MES-102: ENVIRONMENTAL BIOLOGY

MODULE-1  CONCEPT AND SCOPE OF ECOLOGY
1.1 Definition and scope of ecology, branches of ecology
1.2 Human ecology and human settlement
1.3 Historical background of ecology, relevance of ecology to humankind, level of organization in ecology
1.4 Relationship of ecology with other branches of science

MODULE-2  ORIGIN AND EVOLUTION OF BIOLOGICAL DIVERSITY
2.1 General classification of biological diversity (plants and animals)
2.2 Growth and morphogenesis in plants and animals
2.3 Basics of photosynthesis, transpiration, biological nitrogen fixation, Physiological, biochemical and genetic mechanisms associated with adaptations of plants and animals.

MODULE-3  ECOSYSTEM CONCEPTS AND DYNAMICS
3.1 Principle and concept of ecosystem, types of ecosystems
3.2 Biotic and abiotic components of ecosystem, biomes, ecotones and edge effect, ecological niche and equivalents, ecotype, ecophene and ecological indicator
3.3 Biogeochemical cycling Carbon, Nitrogen, Phosphorus and Sulphur and Hydrological cycles and microbial ecology, C3 and C4 pathways and their significance
3.4 Ecological pyramids of number, biomass and energy, food chain, food web and trophic levels, ecological amplitude and ecological niches, ecological energetics, Decomposition, Ecosystem stability, Ecological Succession.
3.5 Primary and secondary productivity of different ecosystems in the world methods of measurements of productivity and the factors affecting productivity

MODULE-4  POPULATION AND COMMUNITY DYNAMICS
4.2 Definition of community, its characteristics, diversity, dominance, structure, stratification, periodicity, fluctuation within community, Interdependence within community

MODULE-5  STUDY OF DIFFERENT ECOSYSTEMS
5.1 Forest ecosystem- Forest as an ecosystem, distribution of forests, types of forests, economics and ecology of forest, role of forests in protection of species regulation of climate and production of various produce
5.2 Grassland ecosystem - Distribution and types of grasslands, rangelands and biodiversity in grassland, and productivity in grasslands
5.3 Desert Ecosystem and Wastelands-Desert as ecosystems, hot and cold deserts, productivity, characteristics and global distribution of deserts; Desertification process; Types and distribution of wastelands in India
5.4 Aquatic Ecosystem: Lentic and lotic ecosystem, structure, energy flow and productivity in estuaries, marine ecosystem, structure biodiversity and productivity in marine ecosystem

5.5 Wetland Ecosystem: Distribution, energetics and productivity in wetlands. Biodiversity and economic importance of wetlands

**SUGGESTED READINGS**


**NOTE FOR PAPER SETTER:** The question paper will contain TWO QUESTIONS from each unit (Total TEN questions in all) and the candidate will be required to answer ONE QUESTION from each unit (total questions to be attempted will be FIVE) i.e. there will be internal choice within each unit.
MODULE-1 INTRODUCTION TO DISASTERS

1.1 Disasters: Meaning and definitions, difference between disaster and hazard, causal factors, development leading to disaster, characteristics of disasters, forecasting and warning of disasters, elements of early warning systems

1.2 Classification of Disasters: Natural and man-made hazards, hazard zonation and risk assessment, mitigation strategies

1.3 Man-Made Disasters: Types and nature of man-made disasters, general effects and mitigation strategies for manmade disasters

1.4 Biological Disasters: Meaning, types, vulnerability, effects, preparedness and mitigation of Biological disasters

1.5 Chemical and Radiological Disasters: Causes, impacts and management of chemical and radiological disasters

MODULE-2 NATURAL DISASTERS- I

2.1 Natural Disasters: Introduction, meaning, nature and types of natural disasters, general effects of natural disasters

2.2 Earthquake and Seismic Hazards: Origin and severity of earthquakes, effects of earthquakes, risk evaluation, seismic zonation of India with special reference to Himalayan Region, earthquake mitigation measures

2.3 Volcanic Eruptions: Nature, causes, monitoring and mitigation of volcanoes

2.4 Landslides: General characteristics, causes, vulnerability, effects, prediction and warning and risk reduction mitigation measures

2.5 Snow Avalanches: Formation of avalanches, classification, mitigation and management of avalanches

MODULE-3 NATURAL DISASTERS- II

3.1 Floods: Causes of flood, flood and draught, erosion and sedimentation, flood prone areas of India and associated hazards, assessment and management of flood

3.2 Cyclones: Nature and genesis, anticyclones, weather associated with cyclones, Geological changes and other effects

3.3 Tsunami: Origin and nature, causes of tsunamis, wave propagation, impact on coastal areas, warning and prevention, tsunami mitigation measures

3.4 Drought: Meaning, types, general characteristics, causes and impacts, prediction and warning and mitigation measures

3.5 Heat and Cold Waves: Causes and impacts, prevention, preparedness and response

MODULE-4 DISASTER MANAGEMENT

4.1 Disaster Management: Definition, objectives and scope of disaster management, elements of disaster management, role of professionals in the management of disasters, disaster management cycle

4.2 Disaster Response: Response plans, search, rescue and evacuation, community health and casualty management
**MODULE-5 DISASTER MITIGATION AND PREPAREDNESS**

4.1 Disaster Preparedness: Disaster preparedness plans, pre-requisites of preparedness planning, role of Information Technology, education, communication, and awareness in preparedness

4.2 Rehabilitation and Reconstruction (R and R): Social and economic aspects of R and R, Housing, relocation, retrofitting, repairing and strengthening of houses, reinstating livelihoods, national policy on disaster management

**SUGGESTED READINGS**


**NOTE FOR PAPER SETTER:** The question paper will contain TWO QUESTIONS from each unit (Total TEN questions in all) and the candidate will be required to answer ONE QUESTION from each unit (total questions to be attempted will be FIVE) i.e. there will be internal choice within each unit.
MES-104: CURRENT ENVIRONMENTAL ISSUES AND THEIR MANAGEMENT

MODULE-1 GLOBAL WARMING, GREENHOUSE EFFECT AND OZONE PROBLEMS

1.1 Global Warming Potential, Possible Impact of Global Warming
1.2 Greenhouse Effect – Policy Response, Kyoto Protocol, El-NINO- Climate Cycle
1.3 Ozone in the Atmosphere, Ozone Depletion Process, Ozone Hole, Worldwide, Ozone Trends, the Montreal Protocol, Consequence of Ozone Depletion

MODULE-2 ACID RAIN, ATMOSPHERE TURBIDITY AND NUCLEAR

2.1 Introduction, Nature and Development of Acid Rain, Acid Rain and Geology
2.2 Acid Rain and Aquatic Environment, Acid Rain and Terrestrial Environment, Acid Rain and Build Environment
2.3 Acid Rain and Human Health, Mitigation of Acid Rain Problems, Aerosol types, Production and Distribution

MODULE-3 OTHER ENVIRONMENTAL ISSUES

3.1 Introduction, Consequences of global CO₂ changes; Strategies for Conservation of Environmental Changes Induced by CO₂ Rise
3.2 Problems of slums in urban cities, Cancer and AIDS, Descriptive and analytical markers and indicators of pollutants in the body; Water-borne, air borne, vector borne, genetic, contagious and non-contagious diseases and their management, Sanitation measures to control infectious diseases
3.3 Environmental problems in India (Narmada Dam, Tehri Dam, Almetti Dam, Soil erosion, Formation and reclamation of usar land, alkaline and saline soil; Unsustainable Agricultural Practices and Land Use Planning); recent problems like Delhi smog, crop burning

MODULE-4 ENVIRONMENTAL POLICIES AND REGULATIONS

4.1 Fundamental principles of environmental protection
4.2 Constitutional perspective: Fundamental right to wholesome environment, directive principles of state policy
4.3 National Environmental Policy
4.4 Environmental regulatory framework in India
4.5 Role of international Environmental Agencies-UNEP, GEF, UNFCC and IPCC

MODULE-5 ENVIRONMENTAL TREATIES AND CONVENTIONS

5.1 Stockholm Convention (1972)
5.2 Basel Convention (1989, 1992)
5.3 Earth Submit at Johannesburg (2002)
5.4 Earth Summit Rio De Janeiro (1992, 2012)
5.5 Kyoto Protocol, 1997; Montreal Protocol, 1987; Ramsar Convention on Wetland, 1971
5.6 Paris Agreement (2015)
5.7 Rotterdam Convention on Prior informed consent procedure for certain hazardous chemicals and pesticides in International schedule
5.8 Agenda 21, sustainable development goals, India’s role in various conventions and contributions

**SUGGESTED READINGS**


**NOTE FOR PAPER SETTER:** The question paper will contain TWO QUESTIONS from each unit (Total TEN questions in all) and the candidate will be required to answer ONE QUESTION from each unit (total questions to be attempted will be FIVE) i.e. there will be internal choice within each unit.
MES-105: PRACTICAL I
(MES 101 : ENVIRONMENTAL GEOLOGY AND ATMOSPHERIC SCIENCE)

1. Study and Identification of hand specimens of rock and mineral samples.
2. Sketch of earth system and different geological hazards
3. Determination of soil texture
4. Familiarization with meteorological instruments and their uses.
5. Presentation and interpretation of wind data – wind direction and speed and wind rose for 24 hours, month and season.
6. Preparation of hydro-therm charts on an area.
7. Predication of weather by using meteorological data of specific area.
8. Land slide studies in Himalayan region
9. Slope stability analysis and Landslide zoning

DISTRIBUTION OF MARKS
1. Any two experiment based on environmental geology/atmospheric science 15 Marks
2. Viva-voce 5 Marks
Total 20 Marks

MES-106: PRACTICAL II
(MES 102: ENVIRONMENTAL BIOLOGY)

1. Ecological sampling of an area (line transect, centre point method and quadrant method)
2. Species-area Curve, measurement of biomass and productivity
3. Population structure and regeneration status of ecosystem
4. Collection of litter, soil and plant samples
5. Nutrient and vegetation analysis
6. Calculation of species diversity, similarity index and evenness
7. Visit to aquatic ecosystem and methods for water and plankton collection
8. Study the biodiversity of water and identification of different species
9. Identification and staining of Microorganisms from different effluents.

DISTRIBUTION OF MARKS
1. Any two experiments based on environmental biology 10 Marks
2. Field visit report 5 Marks
3. Viva-voce 5 Marks
Total 20 Marks
MES-107: PRACTICAL III  
(MES 103: ENVIRONMENTAL DISASTERS: MITIGATION AND MANAGEMENT)  
1. Sketching of earth system and different geological hazards  
2. Preparation of hazard zonation maps with special reference to Himachal  
3. Slope stability analysis and landslide zoning  
4. Identification and observation of water scarcity area  
5. Assignment/field visit to disaster affected sites (Report)  

DISTRIBUTION OF MARKS  
1. Any two experiments based on Environmental Disasters  10 Marks  
2. Field visit report  5 Marks  
3. Viva-voce  5 Marks  
Total  20 Marks

MES-108: FIELD STUDY  
(MES 303: CURRENT ENVIRONMENTAL ISSUES AND THEIR MANAGEMENT)  
1. Describing the: a) climate of an urban area; b) yearly variation in the meteorological data  
2. Prepare a report on the environmental problem in the nearby area and suggest remedial measures  

DISTRIBUTION OF MARKS  
1. Field visit reports  15 Marks  
2. Viva-voce  5 Marks  
Total  20 Marks
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<td>MES–204</td>
<td>Environment Impact Assessment</td>
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**Note:** MES 201 to MES 204 will be of 100 marks (Theory-60, Internal Assessment-20 marks and MES–205-MES-208 Practical-20 marks)
MES-201: ENVIRONMENTAL POLLUTION

MODULE-1 INTRODUCTION
1.1 Definition and sources of pollution
1.2 Different types of pollution
1.3 Global and regional scenario of pollution

MODULE-2 AIR POLLUTION
2.1 Types and sources of air pollutants.
2.2 Reaction of pollutants in atmosphere; atmospheric diffusion and stack performance, air quality standards
2.3 Introduction of basic instruments for sampling and analysis of air pollutants
2.4 Effects of air pollutants on flora and fauna, Biological indicators of air pollution, Bio-monitoring of air pollutions

MODULE-3 WATER POLLUTION
3.1 Sources and kinds of water pollution, water quality standards
3.2 Effects of water pollutants on plants (phytoplankton and macrophytes); Effects of water pollutants animals (zooplankton, macro-benthic invertebrates and fish)
3.3 Eutrophication and its impacts on organisms and communities.
3.4 Impact of heavy metals, halogens, radio-nuclides on aquatic flora and fauna.

MODULE-4 NOISE AND LAND POLLUTION
4.1 Physiological, social and psychological effects of noise
4.2 Methods of noise abatement; shock waves and SST; Noise control in vehicles
4.3 Industrial noise control and effects
4.4 National and International standards
4.5 Soil pollution, Sources and management of municipal solid waste, Biomedical waste, Hazardous waste and Industrial waste

MODULE-5 THERMAL and RADIATION POLLUTION
5.1 Thermal pollution: Concept of thermal pollution, sources of thermal pollution, thermal power plant pollution, thermal effects on aquatic life, impacts on water quality, prevention of thermal pollution.
5.2 Radiation pollution: Causes, effects (health hazards) and control measure of radiation pollution.
5.3 Applications of ionizing isotopes in waste water and air pollution analysis and treatment

SUGGESTED READINGS

**NOTE FOR PAPER SETTER:** The question paper will contain TWO QUESTIONS from each unit (Total TEN questions in all) and the candidate will be required to answer ONE QUESTION from each unit (total questions to be attempted will be FIVE) i.e. there will be internal choice within each unit.
MES-202: NATURAL RESOURCES: CONSERVATION AND MANAGEMENT

MODULE-1  NATURAL RESOURCES - FLORA

1.1 Natural resources: introduction, characteristics and classification
1.2 Concept of endemic, extinct and threatened species (endangered, rare, vulnerable and indeterminate species)
1.3 Plants as a natural resource: a general account with reference to timber, food and medicines
1.4 Degradation of plant resources: Causes and Consequences

MODULE-2  NATURAL RESOURCES - WATER AND ANIMALS

2.1 Wild life as natural resources: A general account with special reference to game wildlife and food, wildlife of India
2.2 Depletion of wildlife: causes and consequences
2.3 Fisheries: Status and conservation with special reference to India and Himachal Pradesh

MODULE-3  NATURAL RESOURCES - SOIL AND MINERALS

3.1 Soil as a natural resource, a general account with reference to nutrients and soil biota
3.2 Role of agricultural practices, wind and water erosion in soil degradation
3.3. Origin, distribution and uses of economically important minerals; exploitation of mineral resources from oceans with special reference to India
3.4 Impact of exploitation of minerals on environment, methods of conserving the mineral resources

MODULE-4  NATURAL RESOURCES - ENERGY

4.1 Energy, demand and supply scenario in India, energy conservation measures
4.2 Coal, oil and natural gas (physico-chemical characteristics and energy content of coal, petroleum and natural gas)
4.3. Principles of generation of Hydro energy, wind energy, tidal energy, solar energy, nuclear energy, Biogas, firewood, ptereo-plants, dendro-thermal energy and their application; impacts of large scale exploitation of different forms of energy

MODULE-5  NATURAL RESOURCES-CONSERVATION STRATEGIES and MANAGEMENT

5.1 In-situ conservation of plants and animal species: Natural Parks, Biosphere reserves and sanctuaries
5.2 Ex-situ conservation: Botanical gardens, Zoological parks, tissue culture techniques, cryo-preservation of pollen, seeds and sperms
5.3 Conservation of forests, social forestry and agro-forestry, carbon sequestration
5.4 Conservation of soil and management of grasslands and wetlands

SUGGESTED READINGS


**NOTE FOR PAPER SETTER:** The question paper will contain TWO QUESTIONS from each unit (Total TEN questions in all) and the candidate will be required to answer ONE QUESTION from each unit (total questions to be attempted will be FIVE) i.e. there will be internal choice within each unit.
MES-203: ECOTOXICOLOGY AND RADIATION IMPACTS

MODULE-1  CONCEPT and HISTORICAL BACKGROUND

1.1 Origin and scope of toxicology, relationship with other sciences
1.2 Development of environmental toxicology (Historical and evolutionary Perspective)
1.3 Classification of toxicants, natural and synthetic toxins, sources of toxicants
1.4 Basic concepts of toxicology, types of toxicity, acute and chronic toxicity
1.5 Toxicants and toxicity, factors affecting toxicity, types of toxins and basic mechanism of action

MODULE-2  MODE OF ACTION AND EFFECTS OF TOXICANTS

2.1 Environmental Toxicants: Mode of action of toxicants, factors affecting the metabolism of xenobiotics; transport process mechanism of toxicants, mode of action and impacts of Arsenic, Cadmium, Lead, Mercury, Carbon-Monoxide, Nitrous Oxide, Sulphur Dioxide, Ozone, Cyanide, mode of action of pesticides
2.2 Toxicity impacts: Health impacts of toxicants on human and aquatic life, long-term effects- chronic, carcinogenic, mutagenic and teratogenic effects

MODULE-3  OCCUPATIONAL HEALTH

3.1 Health problems related to occupation (due to dust, heat, stresses, chemicals, toxic gases, insecticides and pesticides and metals) Risk Assessment and Management in the Workplace (Workplace Exposure Assessment, Risk Management in the Workplace)
3.2 Dose response relationship, LD 50, LC 50, toxicity testing, acute toxicity tests
3.3 Sub-acute and chronic toxicity tests, heavy metal toxicity tests

MODULE-4  RADIATION IMPACTS

4.1 Natural and man-made radiation, application of radiations, sources of ionizing radiation, types of ionizing radiation, radiation dose and units, direct and indirect effects
4.2 Dose limits, radiation hazard
4.3 Personal protection and house-keeping and safety rules

MODULE-5  EFFECTS OF RADIATIONS

5.1 Molecular and cellular radiobiology: Biological effects of radiation, Radiation lesions in DNA, Major types of DNA repair, DNA damage and repair, chromosomal aberrations and gene mutations, cell death, cell survival curve, consequences of unrepaired DNA damage, radiobiological definition of cell death, cell cycle effects
5.2 Impact of radiations on biological molecules (proteins, nucleic acids, lipid and carbohydrates)
5.3 Radio-protectors and Industrial safety requirements, industrial radio-protector

SUGGESTED READINGS

NOTE FOR PAPER SETTER: The question paper will contain TWO QUESTIONS from each unit (Total TEN questions in all) and the candidate will be required to answer ONE QUESTION from each unit (total questions to be attempted will be FIVE) i.e. there will be internal choice within each unit.
MES-204: ENVIRONMENT IMPACT ASSESSMENT

MODULE-1 OVERVIEW OF EIA
1.1 Objectives and developmental Concept, origin of EIA, Benefits of EIA, Indian directions guidelines (GOI different notification of EIA).
1.2 Rapid and comprehensive EIA perspectives.
1.3 Sources and collection of data for EIA. Measurement of Impact (Physical, social, economic, natural)

MODULE-2 EIA Methodology
2.1 Outline of EIA process, Screening, Scoping. Purpose of scoping, impact implications, Baseline studies and superimposition of projected plant emission impacts; reliability of database; intrinsic and external database supports and interpretation; checklist, matrices, Overlays and Geographical Information System, Impact analysis and Predictions, Environmental Impact Statement [EIS]; Public hearing as part of EIA; EIA report.

MODULE-3 PREDICTION and ASSESSMENT OF IMPACTS
3.1 Prediction and Assessment of Impacts on Water Environment, Air Environment, Noise Environment, Biological Environment, Cultural and Socio-cultural Environment.
3.2 EIA of River valley project, Hydro power project, Cement plants and Mining
3.3 Prediction and assessment of: Impact of tourism on environment, impact on flora and fauna in Himalayan region

MODULE-4 PUBLIC PARTICIPATION
4.1 Social impact assessment (SIA), Strategic Environmental Assessment (SEA), types of impacts, Public involvement, Public Hearing compulsion, restoration and rehabilitation methodologies, Mitigation criteria, Project modification, Post project analysis.

MODULE-5 ENVIRONMENTAL MANAGEMENT AND ISO CERTIFICATION
5.2 Life Cycle Analysis –LCA. Waste minimization and product augmentation.

SUGGESTED READINGS

**NOTE FOR PAPER SETTER:** The question paper will contain TWO QUESTIONS from each unit (Total TEN questions in all) and the candidate will be required to answer ONE QUESTION from each unit (total questions to be attempted will be FIVE) i.e. there will be internal choice within each unit.
MES-205: PRACTICAL II
(MES 201: ENVIRONMENTAL POLLUTION)

1. Comparative analysis of air sampling from clean and polluted area using key parameters.
2. Demonstration of noise pollution monitoring equipment.
3. Measurement of sounds by db meter in silent, industrial, residential and commercial zones.
5. Field visit to the Pollution Control Board for demonstration of using different apparatus/equipment for studying different types of pollution (report to be submitted)

DISTRIBUTION OF MARKS

1. Any two experiments based on environmental pollution 10 Marks
2. Field visit report 5 Marks
3. Viva-voce 5 Marks
Total 20 Marks

MES-206: FIELD STUDY
(MES 202: NATURAL RESOURCES: CONSERVATION AND MANAGEMENT)

1. To study the dependence of rural community on the natural resources in the nearby locality
2. To study the biodiversity of birds and insects in nearby locality
3. To undertake collection of economically important plants from nearby locality and fix them herbarium sheets

DISTRIBUTION OF MARKS

1. Field visit report on dependence of rural community on the natural resources 7 Marks
2. Field visit report on natural resources/collections 8 Marks
3. Viva-voce 5 Marks
Total 20 Marks
**MES-207: PRACTICAL II**  
*(MES 203: ECOTOXICOLOGY AND RADIATION IMPACTS)*

1. Determination of different toxic elements in air, water, and soil
2. Protocols to evaluate pollutant toxicity
3. Protocol to evaluate the radiation toxicity
4. Visit to nearest industrial areas for evaluating the working conditions of the workers and documentation of safety measures
5. List the sources of toxic substances from nearby industrial area
6. Identifying the sources of toxins in water obtained from different sources.

**DISTRIBUTION OF MARKS**

1. Any two experiments based on Ecotoxicology and impacts of radiation  10 Marks
2. Field visit report  5 Marks
3. Viva-voce  5 Marks

Total  20 Marks

**MES-208: PRACTICAL III**  
*(MES 204: ENVIRONMENTAL IMPACT ASSESSMENT)*

1. Analysis of Socioeconomic survey in the concern village
2. SIA of any project in the nearby village and urban areas
3. Hypothetical EIA of Hydro power project.
4. Hypothetical EIA of Cement plants/ mining
5. Impact study of Tourism in particular city/town/area
6. Impact study of National highways/road construction
7. Hypothetical EIA of Different industries
8. Hypothetical EIA of River valley project
9. Impact study of urbanization/real estate project.

**DISTRIBUTION OF MARKS**

1. Any one experiment based on EIA  10 Marks
2. Field report  5 Marks
3. Viva-voce  5 Marks

Total  20 Marks
### SEMESTER-III

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**Note:** MES 301 to MES 304 will be of 100 marks (Theory-60, Internal Assessment-20 marks and MES–305-MES-308 Practical-20 marks)
MODULE-1  INTRODUCTION TO REMOTE SENSING
1.1 Definition of remote sensing; introduction to concepts and systems, Scope of remote sensing
1.2 Electromagnetic Spectrum; Radiation principles; image characteristics
1.3 Remote sensing systems; remote sensing platform
1.4 Sources of remote sensing information; advantages of remote sensing

MODULE-2  MICROWAVE SENSING
2.1 Types of microwave systems, advantages, band designation, range resolution, azimuth resolution, real and synthetic aperture systems
2.2 Radar equation, radar return and image, Signatures, dielectric properties and interaction with vegetation
2.3 Leveling, Triangulation, Geo-datic survey

MODULE-3  AERIAL PHOTOGRAPHS AND SATELLITE IMAGERIES
3.1 Interaction between light and matter
3.2 Characteristics of aerial photographs
3.3 Visual interpretation of aerial photographs and satellite imageries
3.4 Instruments used in interpretation
3.5 Path and Row Index Maps; selecting and ordering images

MODULE-4  DIGITAL IMAGE PROCESSING
4.1 Introduction to digital image processing, basic concept and principle, image rectification and restoration
4.2 Image enhancement; manipulation; image classification; the output stage; data merging; conclusion

MODULE-5  APPLICATION OF REMOTE SENSING IN ENVIRONMENTAL MANAGEMENT
5.1 Remote sensing in natural resource management - forest resources, water resources, land resources and mineral resources
5.2 Hazard and disaster mapping and management
5.3 Introduction to GIS; principle of GIS; terminology used in GIS; space and time in GIS
5.4 Maps and its characteristics, map scale, map symbology; spatial relationship; data structure and spatial analysis in GIS; GIS data; software used in GIS

SUGGESTED READINGS
NOTE FOR PAPER SETTER: The question paper will contain TWO QUESTIONS from each unit (Total TEN questions in all) and the candidate will be required to answer ONE QUESTION from each unit (total questions to be attempted will be FIVE) i.e. there will be internal choice within each unit.
MES-302: ENVIRONMENTAL CHEMISTRY AND GREEN TECHNOLOGY

MODULE-1  CONCEPT AND SCOPE OF ENVIRONMENTAL CHEMISTRY

1.1 Nomenclature, segments of environment, Concept and scope of Environmental Chemistry

1.2 Chemistry of biologically important molecules, chemistry of water, hydrogen bonding in biological systems

1.3 Chemistry of various organic and inorganic compounds

1.4 Chemistry of hydrocarbon decay, environmental effects, effects on macro and microorganisms

MODULE-2  FUNDAMENTALS OF ENVIRONMENTAL CHEMISTRY

2.1 Stochiometry, Gibb's energy, chemical potential

2.2 Chemical equilibrium, Acid-base reaction, solubility product, solubility of gases in water

2.3 Solubility product, solubility of gases in water the carbonate system unsaturated and saturated hydrocarbons

2.4 Surfactants: Cationic, anionic and nonionic detergents, modified detergents

2.5 Pesticides: Classification, degradation, analysis, pollution due to pesticides and DDT problems, organochlorides, organophosphates, organo-carbamates, herbicides

2.6 Synthetic Polymers: Microbial decomposition, polymer decay, ecological and consideration, Photosensitize additives.

MODULE-3  ENVIRONMENT AND GLOBAL WARMING

3.1 Chemical composition of Air: Classification of Elements, Chemical speciation

3.2 Chemical process for formation of inorganic and organic particulate matter

3.3 Thermo-chemical and Photochemical reaction in the atmosphere, Oxygen and Ozone chemistry, Chemistry of Air pollutants; photochemical smog, O₃, NOₓ, HC CFCS and PAN

3.4 Chemistry of greenhouse gases, emission of CO₂, Consequences of greenhouse gases, their control and remedial measures, threats of Global warming

MODULE-4  PRINCIPLES OF GREEN TECHNOLOGY

4.1 Overview of green chemistry, principles of sustainable and green chemistry

4.2 Waste minimization and climate change

4.3 Introduction to nano-materials and green nanotechnology

4.4 Nano-medical application of green nanotechnologies

MODULE-5  APPLICATION OF GREEN TECHNOLOGY

5.1 Green technology in industries, fuel cell and electric vehicles, solar energy and hydrogen production, energy from alternate sources, solar photovoltaic technology

5.2 Biofuel production (bio-ethanol and biodiesel)

5.3 Biomass, prevention/ minimization of hazardous/ toxic products, production of
biodegradable materials, concept of green building

**SUGGESTED READINGS**

7. Jadhav, H. V. Elements of Environmental Chemistry, Himalaya Publishing House

**NOTE FOR PAPER SETTER:** The question paper will contain TWO QUESTIONS from each unit (Total TEN questions in all) and the candidate will be required to answer ONE QUESTION from each unit (total questions to be attempted will be FIVE) i.e. there will be internal choice within each unit.
MES-303: RESEARCH METHODOLOGY, STATISTICS AND COMPUTER APPLICATIONS

MODULE-1  INTRODUCTION TO RESEARCH AND SCIENTIFIC WRITING

1.1 Characteristics and types of Scientific Research
1.2 Organizing Scientific Research: Experimental Design, Research Methodology, Sampling designs
1.3 Writing research proposals, research paper, reviews, thesis, conference reports, book reviews, project reports, reference writing and scientific abbreviations
1.4 Preparation and delivery of scientific presentations

MODULE-2  BASIC CONCEPTS OF STATISTICS

2.1 Importance and scope of Statistics
2.2 Primary and secondary data - collection of data
2.3 Sampling of data - random and non-random sampling
2.4 Diagrammatic (Line, bar, pie diagram) and Graphic (Histogram, frequency polygon, frequency curve, cumulative frequency curve) representation of data, Measures of central tendency – Mean (AM, GM and HM), Mode and Median.
2.5 Measures of dispersion, skewness and kurtosis

MODULE-3  PROBABILITY DISTRIBUTION

3.1 Probability distribution - Binomial distribution
3.2 Poison distribution
3.3 Normal distribution
3.4 Test of hypothesis, two types of errors
3.5 T-Test for assumed population mean and comparison of two samples

MODULE-4  STATISTICAL TESTS

4.1 Chi square tests and its application
4.2 Co-relation and regression
4.3 Principles of design of experiments. Examples of CRD and RBD
4.4 Analysis of variance (one way and two way analysis of variance)

MODULE-5  COMPUTER APPLICATION AND ENVIRONMENT SYSTEM ANALYSIS

5.1 Basics of Computer: meaning, definition, types and main parts, structure of Central Processing Unit (CPU); Software: Meaning and types, Application of Software, System and customized software, software piracy; Booting: meaning and types
5.2 Operating System and Memory: meaning and types of operating systems, i.e. UNIX, LINUX, MS-DOS, Microsoft Windows; Memory: meaning and types, Storage capacity and Storage media
5.3 Computer Networking and Cybercrime: meaning, types of network, data security, password, firewall, encryption, backups, wireless networking; Internet: Benefits of internet, web browsing, Digital/Cybercrime.
5.4 Application of computers in Environmental Sciences, Environment System
Analysis, Meteorology and Climatology, Surface and Groundwater Hydrology, Environmental Management and Decision Analysis, Databases, Satellite Data, Image Processing and Remote Sensing; Software Models

SUGGESTED READINGS


NOTE FOR PAPER SETTER: The question paper will contain TWO QUESTIONS from each unit (Total TEN questions in all) and the candidate will be required to answer ONE QUESTION from each unit (total questions to be attempted will be FIVE), i.e., there will be internal choice within each unit.
MES-304: TECHNIQUES IN ENVIRONMENTAL MONITORING AND ANALYSIS

MODULE-1 SAMPLING METHODS
1.1 Sampling methodologies for Air, Water, Soil, Noise and Radioactivity in environmental matrices. Sampling protocols- Selection of sites, Time and frequency for sampling.

1.2 Preservation, Storage and Handling of samples. Good Laboratory Practices.

MODULE-2 ANALYTICAL INSTRUMENTS
2.1 Principles, working and applications of High volume sampler, Respirable Sampler, Impactors, Cyclones, Particle Size Analyser, Gas Analysers, Spectrophotometer (UV-Visible), Flame Photometer, Atomic Absorption spectrophotometer (AAS). Head space analysis, leaching tests, and immunoassay.

MODULE-3 ADVANCED MICROSCOPY AND CHROMATOGRAPHS
3.1 Principles, working and applications of Phase contrast, fluorescent, polarization Microscopes, SEM. Gas Chromatograph (GC), GC-MS, HPLC, Ion chromatograph, X-ray diffraction, ED-XRF, WD-XRF, ICP-MS, ICP-AES

MODULE-4 RADIATION DETECTORS AND MONITORS
4.1 Principles and working of radiation detectors- gas filled, scintillation (inorganic and organic) and semiconductor. Principles and working of Alpha Counter, Beta Counter, Gamma-ray Spectrometer, Liquid scintillation Counter, Beta-Gamma survey meters, Alpha, Beta and Gamma contamination Monitors.

SUGGESTED READINGS
5. Murphy, W.J. Analytical Chemistry, American Chemical Society, USA. 1977

NOTE FOR PAPER SETTER: The question paper will contain TWO QUESTIONS from each unit (Total EIGHT questions in all) and the candidate will be required to answer ONE QUESTION from each unit (total questions to be attempted will be FOUR) i.e. there will be internal choice within each unit.
**MES-305: PRACTICAL I**  
*(MES 301: Remote Sensing and GIS)*  
1. Identification and principle techniques of different instrument used for meteorology  
2. Identification and principle techniques of different software’s used for remote sensing and GIS  
3. Study of equipment and materials used in aerial photography and remote sensing  
4. Case studies-aerial photography and satellite imageries  

**DISTRIBUTION OF MARKS**  
1. Any one experiments based on remote sensing and GIS  
2. Viva-voce  
Total  
15 Marks  
5 Marks  
20 Marks  

**MES-306: PRACTICAL II**  
*(MES 302: ENVIRONMENTAL CHEMISTRY AND GREEN TECHNOLOGY)*  
1. Soil sampling, determination of soil color, bulk density, porosity.  
2. Estimation of pH, moisture, conductivity, organic carbon, organic matter, nitrogen, phosphorus and potassium in soil.  
3. Visit to nearby Institute/ organization to study the initiative on green technology.  

**DISTRIBUTION OF MARKS**  
1. Any one experiments based on environmental chemistry and green technology  
2. Report on field visit  
3. Viva-voce  
Total  
10 Marks  
5 Marks  
5 Marks  
20 Marks
MES-307: PRACTICAL III
(MES 104: RESEARCH METHODOLOGY, STATISTICS AND COMPUTER APPLICATIONS)

1. To find out the mean, mode, median of the given data
2. To study random variables community
3. Application of chi-square and T-test for the given data
4. To study the use computer in analysis of environmental data

DISTRIBUTION OF MARKS

1. Any two experiments based on Statistics 10 Marks
2. Any one experiment based on Computer Applications 5 Marks
3. Viva-voce 5 Marks
Total 20 Marks

MES-308: PRACTICAL IV
(MES 304: TECHNIQUES IN ENVIRONMENTAL MONITORING AND ANALYSIS)

1. Estimation of halides in water samples by potentiometry
2. Estimation of Co2+ and Ni2+ by colorimetry / spectrophotometry
3. Estimation of sulphates by turbidometry
4. Estimation of alkali metals in various samples by flame-photometry
5. Estimation of BOD, DO, COD, TOC, MPN, TSS, TDS in Water and Waste Water
6. Collection of water sample, analysis of water sample related to different elements/Metals
7. Principles of spectrophotometer
8. Principles of Flame photometer
9. Analysis of camions in solution
10. Estimation of iron (III) by photo chemical reduction method
11. Determination of calcium hardness and magnesium hardness of water sample
12. Determination of chloride in a sample of water (silver nitrate method)

DISTRIBUTION OF MARKS

1. Any two experiments based on environmental chemistry 15 Marks
2. Viva-voce 10 Marks
Total 20 Marks
## Semester: IV

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<td>MES-401</td>
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**Note:** MES 401 and 402 will be of 100 marks (Theory-80, Internal Assessment-20 marks). The students are required to opt one optional paper from MES-402 (i)- MES-402 (vii)
**MES-401: ENVIRONMENTAL LAW, GOVERNANCE, ETHICS AND POLICY**

**MODULE-1 INTRODUCTION TO ENVIRONMENTAL LAWS**

1.1 Historical background of Environmental Law and Policy in India
1.2 Constitutional mandate for environmental protection
1.3 Environmental Protection: Issues and Problems
1.4 Key International Efforts for Environmental protection
1.5 Sustainable Development: Essential features and Legal Implications
1.6 UN Framework Conventions on Climate Change, 1992, Kyoto Protocol, 1997

**MODULE-2 ENVIRONMENTAL PROTECTION AND LAW**

2.1 Environmental laws, environmental Policy in India, Indian Constitution and Environmental Protection
2.2 Environment (Protection) Act, 1986: Salient Features
2.3 Powers of Central Government under EPA
2.4 Prevention, Control and abatement of environmental pollution under EPA
2.5 Hazardous wastes (Management, Handling and Transportation) Rules, 2008
2.6 Public Liability Insurance Act, 1991

**MODULE-3 POLLUTION ABATEMENT AND THE LAW**

3.1 Water (Prevention and Control of Pollution) Act, 1974: Salient Features
3.2 Powers and Functions of CPCB and SPCB under Water Act
3.3 Air (Prevention and Control of Pollution) Act, 1981.
3.4 Powers and Functions of CPCB and SPCB under Air Act
3.5 Noise pollution (Regulation and Control) Rules, 2000 (Note: Only relevant provisions of the above Acts)

**MODULE-4 NATURAL RESOURCE CONSERVATION AND THE LAW**

4.1 Wildlife (Protection) Act, 1972: Salient Features
4.2 Protected Areas and Trade and Commerce under WPA
4.3 National Forest Policy
4.4 Forest Conservation Act, 1986
4.5 Biological Diversity Act, 2002

**MODULE-5 JUDICIAL ACTIVISM AND ENVIRONMENTAL PROTECTION**

5.1 Judicial Response towards Environmental Protection
5.2 Public Nuisance under IPC (Sections 268,277,278,284, 290,291)
5.3 Sections 133-143 of Criminal Procedure Code, 1973
5.4 Role of UN authorities in protection of Global Environment
5.5 Evolution of International Environmental Law, International Environmental Law and the Challenge of Globalization
5.6 Recent Trends in International Law

SUGGESTED READINGS


NOTE FOR PAPER SETTER: The question paper will contain TWO QUESTIONS from each unit (Total TEN questions in all) and the candidate will be required to answer ONE QUESTION from each unit (total questions to be attempted will be FIVE) i.e. there will be internal choice within each unit.
INTRODUCTION
1.1 Biodiversity: Basic concepts, importance and conservational needs
1.3 Factors for decline of biological diversity
1.4 Approaches for conservation of biological diversity
1.5 Protection of wild flora, fauna and natural habitats, concept of threatened species, threatened and endangered animals of India

CONCEPT OF BIODIVERSITY
2.1 Biodiversity Convention, international and national efforts to conserve biodiversity
2.2 Concept of genetic diversity, gene and germplasm banks
2.3 Socio-cultural aspects of biodiversity, traditional knowledge and biodiversity conservation

WILDLIFE AND WILDLIFE HABITAT
3.1 Wildlife: definition, concept and importance of wildlife in biological studies
3.2 Methods of studying wildlife (birds and mammals) in their natural habitat
3.3 Wildlife habitat: Forest, desert and Grassland with their characteristics

ENVIRONMENTAL DEGRADATION AND WILDLIFE
4.1 Wildlife damages: Assessment and impact of environmental pollutants on wildlife
4.2 Changed land use pattern and its effects on wildlife
4.3 Man-wildlife conflict
4.4 Wildlife management principles

STATUS and DISTRIBUTION OF WILDLIFE IN INDIA
5.1 Zoo-geographic subdivisions of India based on important mammalian fauna.
5.2 Endangered Wildlife species (Birds and Mammals) of India
5.3 Important Wildlife species of HP State
5.4 Conservation sites of HP with characteristic Wildlife
5.5 Important National Parks, Wildlife Sanctuaries and Biosphere Reserves in India with characteristic Wildlife

SUGGESTED READINGS

**NOTE FOR PAPER SETTER:** The question paper will contain TWO QUESTIONS from each unit (Total TEN questions in all) and the candidate will be required to answer ONE QUESTION from each unit (total questions to be attempted will be FIVE) i.e. there will be internal choice within each unit.
MODULE-1 ECONOMY AND THE ENVIRONMENT
1.1 World environmental history and economic development, valuation of natural resources, Inter-linkages between the economy and the environment

MODULE-2 ENVIRONMENTAL POLICY
2.1 Design of Environmental Policy. Economic Instruments for Environmental Protection: Command and Control versus Incentives and Subsidies. Effectiveness of these instruments. Indian scenario and comparisons with developed countries.

MODULE-3 SUSTAINABLE DEVELOPMENT
3.1 Concept and objectives. Strategic Planning for Sustainable Development, Natural resource based economic and social development.
3.2 Climate Change and India: Vulnerability of regions and populations – Adaptation options.

MODULE-4 GREEN ECONOMY

SUGGESTED READINGS

NOTE FOR PAPER SETTER: The question paper will contain TWO QUESTIONS from each unit (Total EIGHT questions in all) and the candidate will be required to answer ONE QUESTION from each unit (total questions to be attempted will be FOUR) i.e. there will be internal choice within each unit.
MODULE-1  ENVIRONMENTAL HEALTH: INTRODUCTION

1.1 Health and Environment (Historical perspective, basic requirement of healthy environment, environmental quality, human exposure to noxious substances in environment)

1.2 Environmental factors affecting health, environmental health problems and its causes

1.3 Nature of Environmental Health Hazards (Biological, chemical, physical, mechanical and psychological hazards)

1.4 Psychology and work environment; emerging issues; place attachment, pro-environmental behavior, ecological consumerism

MODULE-2  ENVIRONMENTAL HEALTH PROBLEMS-I

2.1 Health problems linked with unsafe water (Toxic pollutants their impacts on health)

2.2 Water-borne diseases (National scenario of water-borne diseases in India)

2.3 Social and quality dimensions of water and sanitation, sanitations and health related challenges

2.4 Vector-borne diseases: Malaria, Kala azar, Japanese Encephalitis, Dengue, Plague, (causal agents, manifestation of disease, prophylactic measures); Airborne diseases: Chickenpox, Influenza, Measles, Smallpox, and Tuberculosis (causal agents, manifestation of disease, prophylactic measures)

MODULE-3  OCCUPATIONAL HEALTH PROBLEMS-II

3.1 Diseases caused by chemical agents (beryllium, phosphorus, cadmium, selenium, phosgene, ammonia)

3.2 Diseases caused by physical agents: Hearing impairment caused by noise, Diseases caused by vibration (disorders of muscles, tendons, bones, joints, peripheral blood vessels or peripheral nerves); diseases caused by compressed or decompressed air; diseases caused by optical (ultraviolet, visible light, infrared) radiations including laser; diseases caused by exposure to extreme temperatures

3.3 Occupational cancer: cancers caused due to Asbestos, Benzidine, Chromium, Nickel compounds, Arsenic, Cadmium

MODULE-4  OCCUPATIONAL SAFETY AND HEALTH

4.1 Occupational safety and health policy: General framework, employers’ responsibilities, workers’ duties and rights, safety and health committees

4.2 Management of occupational safety and health: Management commitment and resources, workers’ participation, training, organizational aspects

4.3 Health promotion, education and training: Promotion of occupational safety and health; training and information at the national level; Training and information at the enterprise level; Training methods and materials
MODULE-5  ENVIRONMENTAL HEALTH MANAGEMENT

5.1 Priority areas for intervention (safe water supply, food safety, basic sanitation, solid waste management, vector control, public information and media), obstacles and opportunities for management of environmental health problems

5.2 Role of environment health professionals, environment and value education, biodiversity conservation and health education, health education for self-confidence and positive attitude

SUGGESTED READINGS


NOTE FOR PAPER SETTER: The question paper will contain TWO QUESTIONS from each unit (Total TEN questions in all) and the candidate will be required to answer ONE QUESTION from each unit (total questions to be attempted will be FIVE) i.e. there will be internal choice within each unit.
MES-402 (iv): SPECIAL PAPER: ENVIRONMENTAL BIOLOGY (OPTIONAL)

MODULE-1 BIOSPHERE AND ITS EVOLUTION


1.2 Origin of living matter, composition of biosphere, survival strategies and conservation, toxic chemicals and biosphere catastrophes, biosphere systems.

1.3 Evolutionary relationship between organisms, evolution of earth’s biosphere, energy flow in the biosphere, hydrosphere and water cycle, earth’s oceans, oceans as global temperature regulators

MODULE-2 GLOBAL CLIMATE PATTERNS

2.1 Latitudinal variation in sunlight intensity

2.2 Global air circulation and precipitation patterns

2.3 Regional and local effects on climate, microclimate, global climate change

MODULE-3 STRUCTURE AND DISTRIBUTION OF BIOMASS

3.1 General features of terrestrial biomes

3.2 Disturbance in terrestrial biomes, climate change and terrestrial biomes

3.3 Aquatic biomes, zonation in aquatic biomes

MODULE-4 BIOGEOGRAPHY

4.1 Scope and development, biogeography and ecosystem, plant dispersal and floristic region

4.2 Patterns of distribution, community and ecosystems, conservation biogeography

4.3 Atmospheric factors influencing the biota, edaphic factors influencing the biota, anthropogenic effects on the biota, zoogeographical regions of the old world

MODULE-5 ADVANCES IN ENVIRONMENTAL BIOLOGY

5.1 Biodegradable and eco-friendly products, biodegradable plastics, bio-surfactants, trickling filters, bio-scrubbers and bio-beds

5.2 Bioenergy, biomass production and its utilization, waste material for energy

5.3 Biotechnology in sewage treatment and environment monitoring

5.4 Bio techniques for air pollution abatement and order control (bio-scrubbers, bio-beds, bio-trickling filters), waste water treatment using aquatic plants

SUGGESTED READINGS


NOTE FOR PAPER SETTER: The question paper will contain TWO QUESTIONS from each unit (Total TEN
questions in all) and the candidate will be required to answer ONE QUESTION from each unit (total questions to be attempted will be FIVE) i.e. there will be internal choice within each unit.
MESA-402 (v): SPECIAL PAPER: CLIMATE CHANGE AND CLEAN TECHNOLOGY

MODULE-1 SCIENCE OF CLIMATE CHANGE

MODULE-2 GREEN HOUSE GASES
2.1 Trends of Emission of Carbon dioxide, Nitrous Oxide, methane, CFCs, Sulphur hexafluoride. GHG inventories. Sectoral emissions. Time series plots of GHGs and temperature.

MODULE-3 CLIMATE CHANGE IMPACTS
3.1 Impact of Climate Change on weather and climatic patterns, ice caps, glaciers, agriculture, vegetation, biodiversity, sea level, tourism and their implications.

MODULE-4 CLEAN TECHNOLOGY
4.1 Imperatives of clean technology in the context of mitigation and adaptation measures. CDM concept, CDM scenario in India, CDM projects sector-wise, National Action Plan on Climate Change, sustainable habitat, concept of Green architecture. Carbon trading; carbon credits; Carbon sequestration; Carbon Footprint. Issues of Energy security, Food Security and Social security.

SUGGESTED READINGS

NOTE FOR PAPER SETTER: The question paper will contain TWO QUESTIONS from each unit (Total EIGHT questions in all) and the candidate will be required to answer ONE QUESTION from each unit (total questions to be attempted will be FOUR) i.e. there will be internal choice within each unit.
MODULE-1  EIA NOTIFICATION
1.1 EIA in Indian context, EIA Notification 2006, Prior environmental clearance requirements, EIA authority - State and Central government, Committees for Environmental Clearance, Application for EC, Form 1- contents. Categorization of projects, list of projects, activity, financial overlays, conditions and specifications.

MODULE-2  PROJECT TYPES
2.1 General idea, categorization criteria important considerations/features developmental projects - mining, cement industry, group housing, Township development, commercial malls, Star hotels, educational institutions, thermal power, textile, pulp and paper industry, biomass energy, fertilizer industry, Road/highway construction, Bridge construction, Railway lines, Airports and SEZ.

MODULE-3  REPORTS FOR ENVIRONMENTAL CLEARANCE

MODULE-4  ENVIRONMENTAL AUDIT
4.1 Objectives, frequency and criteria audit team, Environmental appraisal, accounting and environmental audit. Environmental guidelines for siting of industry, Green Balance Sheet (GBS), Status of compliance of mandatory and voluntary requirements for industries - mineral, cement, pesticide and textile.

SUGGESTED READINGS
4. GOI – Ministry of MoEF Gazette Notification under sub-rule (3) of Rule 5 of Environment (Protection) Rules. 2006.
NOTE FOR PAPER SETTER: The question paper will contain TWO QUESTIONS from each unit (Total EIGHT questions in all) and the candidate will be required to answer ONE QUESTION from each unit (total questions to be attempted will be FOUR) i.e. there will be internal choice within each unit.
MES-402 (vii): SPECIAL PAPER: PRINCIPLES OF CLIMATOLOGY (OPTIONAL)

MODULE-1 INTRODUCTION
1.1 Definition, sub-divisions and scope of climatology
1.2 Composition and structure of the atmosphere
1.3 Insolation; Factors governing insolation; Heat budget of the Earth; Factors determining horizontal distribution of temperature

MODULE-2 PRESSURE AND WIND
2.1 Factors controlling pressure, horizontal distribution of pressure; Factors controlling wind
2.2 Wind system; Types of planetary winds; Local winds and types; Measurement of wind, air temperature and insulation

MODULE-3 AIR
3.1 Air masses, air fronts and their types; Climatic classification- Basis of classification; Koeppen’s classification; Thornthwait’s classification- 1931 scheme, 1948 scheme, concept of El-Nino, Southern oscillation (ENSO) and La-Nina
3.2 Weather Forecasting - Tools in weather forecasting; Weather Forecasting in India

MODULE-4 CLIMATE OF THE WORLD
4.1 Describing the climatic features and native vegetation of the following: Equatorial, Savanna, Hot Desert, Mediterranean, Steppe

MODULE-5 CLIMATE CHANGE
5.1 Hazards - Fog and thunderstorm; Effect of climate on vegetation; Bioclimatology -Climate and Human Health
5.2 Climate and House types; Climatic change-Indicators of past climate, Carbon dioxide theory, Volcanic dust theory

SUGGESTED READINGS

**NOTE FOR PAPER SETTER:** The question paper will contain TWO QUESTIONS from each unit (Total TEN questions in all) and the candidate will be required to answer ONE QUESTION from each unit (total questions to be attempted will be FIVE) i.e. there will be internal choice within each unit.

**MES-403: DISSERTATION**

In MES-403, the students will undertake field study/experimental study, which will be submitted as dissertation and will be evaluated by external/ internal examiners. The viva-voce/presentations will be conducted by the external/ internal examiners.