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

M.Sc. (Environmental Sciences)

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. 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. The course has following career Opportunities:

- Industry (Environmental Impact Assessment, Sustainable Resource Management, Waste Management, Environmental Biotechnology, Eco-technology)
- 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

The probable learning outcomes of the M.Sc. (Environmental Sciences) shall include the following:

Knowledge & Understanding:

- Establish systematic knowledge of Environmental Science.
- Insightfully address the contemporary environmental issues both of national and global importance.
- Engage in the field of Environmental Sciences and associated areas.

Skills & Techniques:

- Show the aptitude to apply the knowledge in an organized way for the evaluation and clarification of environmental issues pertaining to ecosystems, air, water, and soil pollution, human health hazards; biodiversity loss, food security and agricultural issues.
- Establish the ability to recognize the role of Environmental Sciences in evolving sustainable solutions to the environmental issues
- Demonstrate the skill to plan and develop eco-friendly solutions and processes for realizing the goals of sustainable.

Competence:

- Communicate efficiently
- Skilled to work as in team and contribute for effective planning, management, and implementations of projects/programme
- Exhibit capability to think and implement independent research projects/programme and evaluate the outcomes

Programme Outcomes (PO)

1. Gained thorough understanding of environmental problems at local, regional and global level;
2. Gained skills to apply the knowledge to the environmental challenges before the society
3. Expanded research insight and developed critical thinking on contemporary instrumentation and analytical techniques related to environmental sciences;
4. Obtained exposure and articulation to disseminate the information about environmental concerns, issues, their impacts and mitigation plans
5. Acquired the sense of responsibility to safeguard the environment and application of knowledge for effective decision-making with regard to environmental problems

After completion of this program, the learners will have:

- knowledge about different facets of local, regional and global environmental problems.
- environmental monitoring and data analysis skills
- exposure to the environmental pollution control knowhows
- knowledge and skills desirable for the environmental management
- abilities and aptitudes in the preparation, planning and implementation of environmental projects

The students after completing M.Sc. (Environmental Sciences) will have the job opportunity in the field of teaching, research projects, industries /municipal bodies, pollution control boards, environmental monitoring projects, consultations, NGOs, and numerous fields linked with the field of environment.

Program Specific Outcomes (PSO)

The course will help in understanding the:

- basic concepts of environment and its elements and their interface through study of ecology, biodiversity, green chemistry, disaster management etc.
- different kinds of pollutions and their sources including the hazardous waste & Eco-toxicology and different laws about pollution
- tools for the management of environment, remote sensing, energy resources, biodiversity conservation Environmental analytical techniques, like water and wastewater treatment, solid wastes, biostatistics etc.

Course Outcomes

SEMESTER I
MES–101 Environmental Geology and Atmospheric Science
• Ability to demonstrate comprehensive understanding of Environment and environmental geo-science • Ability to establish comprehensive understanding of Geomorphological processes • Ability to recognize and describe environmental geochemistry, atmosphere, weather and climate
MES–102 Environmental Biology
• Ability to recognize the concept and Scope of Ecology • Ability to establish comprehensive understanding of origin and evolution of biological diversity • Ability to demonstrate comprehensive understanding of ecosystem concepts its types and dynamics
MES–103 Environmental Disasters: Mitigation and Management
• Ability to demonstrate sound understanding on disasters, their types and nature • Ability to examine the details of earthquake and seismic hazards, volcanic eruptions, landslides, snow avalanches, floods, cyclones, tsunami, droughts, heat and cold waves; • Learn the mitigation approaches, concept of disaster management and preparedness
MES–104 Current Environmental Issues and their Management
• Ability to recognize the concept of global warming, greenhouse effect and ozone problems • Ability to demonstrate sound understanding of the concept of acid rain, atmosphere turbidity and nuclear • Ability to Summarize the relevant environmental policies, regulations, environmental treaties and conventions
SEMESTER II
MES–201 Environmental Pollution
• Ability to demonstrate sound understanding of definition of pollution, sources of pollution, different types of pollution • Ability to address the global and regional scenario of pollution

• Ability to integrate and use knowledge of air pollution, water pollution, noise and land pollution, thermal and radiation pollution
MES–202 Natural Resources: Conservation and Management
• Ability to demonstrate comprehensive understanding of natural resources, natural resources, characteristics and classification • Ability to recognize and describe water, soil, minerals and energy resources • Ability to realize the usefulness of natural resources-conservation strategies and management
MES–203 Ecotoxicology and Radiation Impacts
• Ability to demonstrate understanding of the concept and historical background of ecotoxicology • Ability to apply the basic concepts of toxicology, types of toxicity, acute and chronic toxicity • Building the foundation for understanding the mode of action and effects of toxicants, occupational health, radiation impacts and effects of radiations
MES–204 Environment Impact Assessment
• Develop capability to understand the concept of Environment Impact Assessment • Obtain basic capability in skills and functional knowledge to carry out EIA • Develop capability in prediction and assessment of impacts, public participation, environmental management and ISO certification
SEMESTER III
MES–301 Remote Sensing and GIS
• Ability to demonstrate sound understanding of Remote Sensing • Ability to deal with microwave sensing, aerial photographs and satellite imageries, digital image processing • Develop capability to handle remote sensing tools in environmental management
MES–302 Environmental Chemistry and Green Technology
• Ability to appreciate the concept and scope of environmental chemistry • Ability to demonstrate sound understanding of the fundamentals of Environmental Chemistry • Ability to critically examine the issues environment and global warming, principles and applications of Green Technology

MES–303 Research Methodology, Statistics and Computer Applications
• Ability to demonstrate sound understanding of research and scientific writing • Ability to appreciate basic concepts of statistics, probability distribution and statistical tests • Ability to understand the computer application and environment system analysis
MES–304 Techniques in Environmental Monitoring and Analysis
• Ability to demonstrate sound understanding of analytical techniques applied in environmental analyses • Ability to design of monitoring and sampling methods using analytical instruments • Ability to deal with advanced microscopy and chromatographs, radiation detectors and monitors
SEMESTER IV
MES–401 Environmental Law, Governance, Ethics and Policy (Compulsory paper)
• Ability to demonstrate understanding of environmental laws • Ability to apply critical mind in policy and approach aimed at environmental protection, judicial activism and environmental protection • Ability to comprehend the pollution abatement laws, natural resource conservation laws and recent trends in International Law
MES–402 (i) Special Paper I: Biodiversity and Wildlife Ecology (Optional paper)
• Ability to appreciate the basic concepts, importance and biodiversity conservational needs • Ability to understand environmental degradation and wildlife • Ability to comprehend on the status and distribution of wildlife in India
MES–402 (ii) Special Paper II: Environment Economics (Optional paper)
• Comprehend the fundamental concepts of economy and the environment • Recognize the utility of environmental policy • Ability to demonstrate understanding and appreciate the concept of green economy
MES–402 (iii) Special Paper III: Environmental Health (Optional paper)
• Understand the general knowledge of environmental factors affecting health, environmental health problems and its causes

• Understand the processes and mechanisms of environmental health hazards (Biological, chemical, physical, mechanical and psychological hazards) • Develop critical thinking in the matter of health problems viz. water-borne diseases, vector-borne diseases, diseases caused by chemical and physical agents
MES–402 (iv) Environmental Biology (Optional paper)
• Develop critical thinking in biosphere and its evolution, global climate patterns • Understand the structure and distribution of biomass and biogeography • Develop understanding of advances in environmental biology
MES–402 (v) Climate Change and Clean Technology (Optional paper)
• Ability to demonstrate systematic understanding of science of climate change, greenhouse gases • Ability to understand the impacts of climate change • Ability to appreciate clean technology
MES–402 (vi) Environmental Clearance and Environmental Audit (Optional paper)
• Ability to demonstrate understanding of EIA Notification • Ability to apply knowledge of environmental clearance • Ability to evaluate the process linked with Environmental Audit
MES–402 (vii) Principles of Climatology (Optional paper)
• Ability to appreciate the definition, sub-divisions and scope of climatology • Ability to demonstrate understanding of pressure, wind system, climate of the World • Ability to analyse the process and impacts of climate change
MES–403 Dissertation
• 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. Ability to identify the gap based to a survey of the relevant literature • Skill to undertake field study in a systematic way • Capacity to work independently on a scientific question and arrive at a conclusion

Mapping of Course with Program Outcomes (POs)

Programme Outcomes	PO1	PO2	PO3	PO4	PO5
MES–101 Environmental Geology and Atmospheric Science					
MES–102 Environmental Biology					
MES–103 Environmental Disasters: Mitigation and Management					
MES–104 Current Environmental Issues and their Management					
MES–201 Environmental Pollution					
MES–202 Natural Resources: Conservation and Management					
MES–203 Ecotoxicology and Radiation Impacts					
MES–204 Environment Impact Assessment					
MES–301 Remote Sensing and GIS					
MES–302 Environmental Chemistry and Green Technology					
MES–303 Research Methodology, Statistics and Computer Applications					
MES–304 Techniques in Environmental Monitoring and Analysis					
MES–401 Environmental Law, Governance, Ethics and Policy (Compulsory paper)					
MES–402 (i) Special Paper I: Biodiversity and Wildlife Ecology (Optional paper)					
MES–402 (ii) Special Paper II: Environment Economics (Optional paper)					

MES–402 (iii) Special Paper III: Environmental Health (Optional paper)					
MES–402 (iv) Environmental Biology (Optional paper)					
MES–402 (v) Climate Change and Clean Technology (Optional paper)					
MES–402 (vi) Environmental Clearance and Environmental Audit (Optional paper)					
MES–402 (vii) Principles of Climatology (Optional paper)					
MES–403 Dissertation					

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

- Industry (Environmental Impact Assessment, Sustainable Resource Management, Waste Management, Environmental Biotechnology, Eco-technology)
- 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

COURSE NO	TITLE OF COURSE	Marks		
FIRST SEMESTER		**Theory**	**Internal Assessment**	**Total**
MES–101	Environmental Geology and Atmospheric Science	60	20	80
MES–102	Environmental Biology	60	20	80
MES–103	Environmental Disasters: Mitigation and Management	60	20	80
MES–104	Current Environmental Issues and their Management	60	20	80
MES–105	Practical I (MES 101)	20	-	20
MES–106	Practical II (MES 102)	20	-	20
MES–107	Practical III (MES 103)	20	-	20
MES-108	Field Study (MES 104)	20	-	20
Total				**400**
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)				
COURSE NO.	**TITLE OF COURSE**	**Marks**		
SECOND SEMESTER		**Theory**	**Internal Assessment**	**Total**
MES–201	Environmental Pollution	60	20	80
MES–202	Natural Resources: Conservation and Management	60	20	80
MES–203	Ecotoxicology and Radiation Impacts	60	20	80
MES–204	Environment Impact Assessment	60	20	80
MES–205	Practical I (MES 201)	20	-	20
MES–206	Field Study (MES 202)	20	-	20
MES–207	Practical II (MES 203)	20	-	20
MES-208	Practical III (MES 204)	20	-	20
Total				**400**
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.

COURSE NO.	TITLE OF COURSE	Marks		
THIRD SEMESTER		**Theory**	**Internal Assessment**	**Total**
MES–301	Remote Sensing and GIS	60	20	80
MES–302	Environmental Chemistry and Green Technology	60	20	80
MES–303	Research Methodology, Statistics and Computer Applications	60	20	80
MES–304	Techniques in Environmental Monitoring and Analysis	60	20	80
MES–305	Practical I (MES 301)	20	-	20
MES–306	Practical II (MES 302)	20	-	20
MES–307	Practical III (MES 303)	20	-	20
MES-308	Practical IV (MES 304)	20	-	20
Total				**400**
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)				
COURSE NO.	**TITLE OF COURSE**	**Marks**		
FOURTH SEMESTER		**Theory**	**Internal Assessment**	**Total**
MES–401	Environmental Law, Governance, Ethics And Policy (Compulsory paper)	80	20	100
MES–402 (i)	Special Paper I: Biodiversity and Wildlife Ecology (Optional paper)	80	20	100
MES–402 (ii)	Special Paper II: Environment Economics (Optional paper)	80	20	100
MES–402 (iii)	Special Paper III: Environmental Health (Optional paper)	80	20	100
MES–402 (iv)	Environmental Biology (Optional paper)	80	20	100
MES–402 (v)	Climate Change and Clean Technology (Optional paper)	80	20	100
MES–402 (vi)	Environmental Clearance and Environmental Audit (Optional paper)	80	20	100
MES–402 (vii)	Principles of Climatology (Optional paper)	80	20	100
MES–403	Dissertation	100	-	100
Total				**300**
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

COURSE NO.	TITLE OF COURSE	Marks		
FIRST SEMESTER		**Theory**	**Internal Assessment**	**Total**
MES–101	Environmental Geology and Atmospheric Science	60	20	80
MES–102	Environmental Biology	60	20	80
MES–103	Environmental Disasters: Mitigation and Management	60	20	80
MES–104	Current Environmental Issues and their Management	60	20	80
MES–105	Practical I (MES 101)	20	-	20
MES–106	Practical II (MES 102)	20	-	20
MES–107	Practical III (MES 103)	20	-	20
MES-108	Field Study (MES 104)	20	-	20
Total				**400**

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

1. Bennett, M. R. and Doyle, P. Environmental geology: - Geology and the Human Environment. John Wiley and Sons.1997.
2. Botkin, Daniel B. and Keller, Edward A. Environmental Science: Earth as a Living Planet. 6th ed. John Wiley and Sons, USA. 2007.

3. Bouwer, H. Groundwater Hydrology. McGraw-Hill, New York. 1978.
4. Butz, S. D. Science of Earth Systems. 2nd ed. Thomson Delmar Learning, USA 2004
5. Eby, N. Principles of Environmental Geochemistry. Brooks Cole, USA. 2003
6. Joseph, G. Fundamentals of Remote Sensing. Universities Press (India) Pvt. Ltd. 2007.
7. Keller, E.A. Environmental Geology. 8th ed. Prentice Hall of India 1999.
8. Keller, E.A. Introduction to Environmental Geology. 4th ed. Prentice Hall of India 2007.
9. Kemp, M. J. Environmental Science. The McGraw-Hill Companies. 1997.
10. Raven, Peter H., Berg, Linda R. and Hassenzahl, David, M. Environment. 6th ed. John Wiley and Sons., USA. 2008.
11. Schwartz, F.W. and H. Zhang. Fundamentals of Ground Water. John Wiley and Sons, USA. 2003.

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

4.1 Characteristics of Population, concept of carrying capacity, Population growth and regulation, Population fluctuation, dispersion and meta- population. Concept of r and k species, key stone species.

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

1. Agrawal, K. C. (2008) Environmental Biology, Nidhi Pub, New Delhi
2. Benton, A.H. and Werner, W.E. (1976) Field Biology and Ecology, Tata Mc. Graw Hill Publishing Company Ltd. New Delhi
3. Chapman, J. L. and Reiss, M. J. (1995) Ecology- Principles and applications, Cambridge University Press, New York
4. Claude F., Ferra, C., Medori, P. andDevaux, J. (2001) Ecology. Sciences and Practice, Oxford and IBH Pub. Co. Pvt. Ltd. New Delhi
5. Dash, M. C. (1993) Fundamentals of Ecology. Tata Mc.Graw Hill Publishing Company Ltd. New Delhi.
6. Grover, I. S. and Thukval, A. K. (1998) Environmental Development, Scientific Publishers, New Delhi
7. Kormondy, E. J. (1986). Concept of Ecology. Prentice Hall of India, New Delhi.
8. Odum, E. P. (1996). Fundamentals of Ecology. Natraj Publishers, Dehradun.
9. Prasad, S. N. (2009) Environmental Biology, Campus Book International
10. Sharma, P. D. (2009) Ecology and Environment Environmental, Rastogi Publication, New Delhi
11. Sharma, R. D. (1994) Himalayan Eco-System Development, Concept Publishing Company, New Delhi

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-103: ENVIRONMENTAL DISASTERS: MITIGATION AND MANAGEMENT

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

1. Bryant, E. A. (1991) Natural Hazards. Cambridge University Press, Cambridge, New York.
2. Cuny, F. (1983) Disasters and Development. Oxford University Press, England.
3. Cutter, S. L. (1999) Environmental Risks and Hazards. Prentice Hall of India Pvt. Ltd. New Delhi
4. Green, S. (1980) International Disaster Relief towards a Responsive system. Mc. Graw Hill Book Co. New York.
5. Gupta, H. (2003) Disaster Management. University Press, Hyderabad.
6. Sahini, P. and Ariabandu, M. N. (2003) Disaster Risk Reduction in South Asia. Prentice Hall of India Pvt. Ltd. New Delhi.
7. Sinha, P. C. (1998) Encyclopedia of Disaster Management series. Anmol Pub., New Delhi.
8. Singh, S. R. (2011) Disaster Management. APH Publishing Corporation, New Delhi.
9. Smith, K. (1996) Environmental Hazards: Assessing risk and reducing disaster. Routledge, London.

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, EI-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 CO_2 changes; Strategies for Conservation of Environmental Changes Induced by CO_2 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 POLICES 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

1. Bridgeman, Howard, (1991) Global Air Pollution: Problems for the 1990's, Belhaven Press, New York.
2. Joner, J. A. A. (1997) Global Hydrology: Processes, Resources and Environment", Longman, Essenx, England
3. Mauahan, S.E. (1983) Environmental Chemistry, Willaw Grant Press, Beston, USA.
4. Moeller, Dave W. (1992) Environmental Health, Mass: Harvard University Press, Cambridge.
5. Santra, S.C. (2005) Environmental Science, 2nd Edition, New Central Book Agency (P) Ltd, Kolkata, India,
6. Tudge, Colin, (1991) Global Ecology, Oup, New York.
7. Wilson, E.O. (1988) Biodiversity, National Academy Press, Washington, DC.

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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. Slop 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**

SEMESTER – II

COURSE NO.	TITLE OF COURSE	Marks		
SECOND SEMESTER		**Theory**	**Internal Assessment**	**Total**
MES–201	Environmental Pollution	60	20	80
MES–202	Natural Resources: Conservation and Management	60	20	80
MES–203	Ecotoxicology and Radiation Impacts	60	20	80
MES–204	Environment Impact Assessment	60	20	80
MES–205	Practical I (MES 201)	20	-	20
MES-206	Field Study (MES 202)	20	-	20
MES–207	Practical II (MES 203)	20	-	20
MES-208	Practical III (MES 204)	20	-	20
Total				**400**

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

1. Bretsehnedder, B. and Kurfurst, J. (1987) Air Pollution, Elsevier Scientific Pub. Co. Amsterdam, Oxford, New York.
2. Bridgman, H. (1992) Global Air Pollution, CBS Pub. New Delhi.
3. Bush, M. B. (1997) Ecology of a changing planet, Prentice Hall, USA.
4. Dassber, H. S. and Bortitz, S. (1988) Air pollution and its influence on vegetation, Dr. W. Junk Pub. Dordrencht-Bostan Lancaster.

5. Davis, M.L. and Cornwell, D.A. (1991) Introduction to Environmental Engg, McGraw Hill International Edition.
6. Dhaliwal, G. S., Sawgha, G. S. and Ralhan, P. K. (1996) Fundamentals of Environmental Science, Kalyani Pub., Ludhiana.
7. Edward, C. A. (1976) Environmental Pollution by Pestacades, Plenum Press, London and New York.
8. Naji, G. K.; Dhillon, M.K.; Dhaliwal, G.S.(1999) Noise Pollution, Commonwealth Pub., New Delhi.
9. Odum, E. P. (1996) Fundamentals of Ecology, Natraj Pub. Dehradun.
10. Patrick, R. Dugan (1972) The Water pollution problems (Part-I), Plenium Publishing corporation New York
11. Prasad, O. and Choudhary, M.C. (1992) Environmental Pollution Radiation, Venus Publishing House, New Delhi.
12. Rana, S.V.S. (2003). Essentials of Ecology and Environmental Sciences, Prentice Hall of India, New Delhi.
13. Rao, M. N. and Rao, H.U. (1998) Air Pollution, Tata McGraw Hill Pub. Company, New Delhi.
14. Tripathi, A. K. (1992) Air pollution, Vol. I. Ashish Publishing House, New Delhi

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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, petero-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

1. Bandhu, D. (1987) Environment Education for conservation and Development, Indian Environment, Society New Delhi

2. Chaturvedi, A. N. (1994) Management of India's forest resources. Khanna Bandhu, Dehradun

3. Dar, G.H., Bhagat, R.C. and Khan, M.A. (2002) Biodiversity of the Kashmir Himalaya, Anmol Publication, Pvt. Ltd. New Delhi
4. Dasmann, R.F. (1981) Wildlife Biology, 2nd edition, John Wiley and Sons, New York
5. Gautam, A. and Rastogi, S. (2003). Resource Geography, International Publishing House, Meerut
6. Gupta, K. C. (2002). Energy and Environment in India - A study of Energy Management, Gyan Publishing House, New Delhi
7. Heywood, V.H. (1995) Global Biodiversity Assessment, Cambridge University Press, UK
8. Jadhav, H. V. (1997) Energy and Environment, Himalaya Publishing House. Delhi.
9. Jairajpuri, M. S. (1991) Animal Resources of India - Protozoa to mammalia - State of the Art, Zoological survey of India. XI-XXVII
10. Kathiresan, S. B. (1986) Essentials of forest management, Natraj Publishers, Dehradun
11. Kumar, H.D. (1995) Modern concepts of Ecology, Vikas Pub. House, Pvt. Ltd. New Delhi
12. Owen, O. S. and Chiras, D.D. (1995) Natural Resources Conservation. Prentice Hall India
13. Rana, S.V.S. (2003) Essentials of ecology and Environmental sciences, Prentice Hall of India
14. Singh, M. P. (2004) Natural Resources and renewable Energy, Daya Publishing House, Delhi
15. Tiwari, P.C. (1995) Natural Resources and sustainable development in Himalaya, Shree Almora Book Depot., India

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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

1. Ansari, A. (2009) Radiation threats and your Safety. Chapman and Hall/CRC
2. Banerjee, S. K. (2001) Environmental Chemistry. Prentice Hall of India Pvt. Ltd., Delhi

3. De, A. K. (2003) Environmental Chemistry. New Age Int. Ltd. New Delhi
4. Donald, G. G. (1998) Environmental Toxicology and Chemistry. Oxford University Press: New York and Oxford
5. Henriksen, T. (2002) Radiation and Health. Taylor and Francis, New York
6. Ian C. Shaw and John Chadwick (1998) Principal of Environmental Toxicology. Taylor and Francis, London
7. Lombardi, M. H. (1998) Radiation Safety in Nuclear Medicine. CRC Press; 1st Edition
8. Mommsen, T. P. and Moon, T. W. (2005) Environmental Toxicology. Elsevier Science
9. Satake, M. Y., Mldo, H., Ysuhisa, S., Taguchi, M. S. Sethi and S. A. Iqbal (1997) Environmental Toxicology. Discovery Pub. House, New Delhi
10. Sood, A. (1999) Toxicology. Sampand Songs, New Delhi.
11. Wright, D. A. and Welbowin, P. (2002)-Environmental Toxicology. Cambridge Univ. Press, U.K.
12. Woodlly, A. (2008). A Guide to Practical Toxicology Evaluation, Prediction, and Risk. Informa Healthcare USA, Inc. 52 Vanderbilt Avenue New York

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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

5.1 Environmental Management Systems (EMS), ISO 14000 (EMS). Components of Environmental Management System-Objectives, Policies, Implementation and Review.

5.2 Life Cycle Analysis –LCA. Waste minimization and product augmentation.

SUGGESTED READINGS

1. Anjaneyulu, Y. and Manickam, V. Environmental Impact Assessment Methodologies. B.S. Publications.2002.
2. Boland, R.G.A. (Ed) Environmental Management Training. Sterling Publishers Pvt. Ltd. New Delhi, 1993.
3. Canter, L. Environmental Impact Assessment.2nd Edition. McGraw-hill Book Company, New York.1996.
4. Cutter, S.L. Environmental Risks and Hazards. Prentice Hall of India, New Delhi. 1999.
5. Glasson, J. Therivel, R. and Chadwick, A. Introduction to Environmental Impact Assessment. Routledge, London. 2006.
6. Kulkarni, V. and Ramachandra, T.V. Environmental Management. Capitol Pub. Co., New Delhi. 2006.
7. Morris, P. and Therivel R. (Eds) Methods of Environmental Impact Assessment. 2nd

Edition, Spon Press London. 2001.

8. Paliwal, U.L. Environment Audit. Indus Valley Publications. Jaipur 2002

9. Petts, J. Handbook of Environmental Impact Assessment- Volume 1 and 2. Blackwell. Publishers, UK 2005.

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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.
4. Estimation of pH, phosphate, sulphate, acidity, alkalinity, conductivity, hardness, turbidity.
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 pants 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 element 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	5Marks
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**

SEMEASTER-III

COURSE NO.	TITLE OF COURSE	Marks		
THIRD SEMESTER		**Theory**	**Internal Assessment**	**Total**
MES–301	Remote Sensing and GIS	60	20	80
MES–302	Environmental Chemistry and Green Technology	60	20	80
MES–303	Research Methodology, Statistics and Computer Applications	60	20	80
MES–304	Techniques in Environmental Monitoring and Analysis	60	20	80
MES–305	Practical I (MES 301)	20	-	20
MES–306	Practical II (MES 302)	20	-	20
MES–307	Practical III (MES 303)	20	-	20
MES-308	Practical IV (MES 304)	20	-	20
Total				**400**

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)

MES-301: REMOTE SENSING AND GIS

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 Surveying

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

1. Burrough, P.A. (1986) Principles of Geographical Information System for Land Resource Assessment, Oxford Univ. Press
2. Curran, P.J. (1988) Principles of Remote Sensing, ELBS, Longman Inc.
3. Jensen, J.R. (1986) Digital Image Processing, Prentice Hall, New York
4. Jensen, J. R. (2003) Remote Sensing of the Environment, Pearson Education, Singapore
5. Lillesand T.M. and Kiefer R.W. (1987) Remote Sensing and Image Interpretation, Second

Ed. John Wiley and Sons, New York

6. Rao, U.R. (1996) Space Technology for Sustainable development, Tata McGraw Hills Co. Ltd., New Delhi

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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 boding 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. O_3, NO_x, HC CFCS and PAN

3.4 Chemistry of greenhouse gases, emission of CO_2, 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

1. Baird, C (2000) Environmental Chemistry, W. H. Freeman and Company, USA
2. Banerji, S. K. (1993) Environmental Chemistry, Prentice-Hall of India Private Ltd., New Delhi
3. De, A. K. (2003) Environmental Chemistry, New Age International Ltd., New Delhi
4. Eisenbund, M. and Gesell, T. (1997) Environmental Radioactivity-from natural, industrial and military sources, Acad. Press, USA
5. Girard, J. E. (2005) Principals of Environmental Chemistry, Jones and Bartlett Publishers, Inc.
6. Harrison, R. M. and Mora, S. J. De. (1996) Introductory chemistry for the Environmental Chemistry. Cambridge University, Press
7. Jadhav, H. V. Elements of Environmental Chemistry, Himalaya Publishing House
8. Mido, Y. and Satake, M. (1995) Chemicals in the environment, Discovery Pub. House, New Delhi.
9. Sharma, B. K. (2001) Environmental Chemistry, Krishna Prakashan Media Pvt. Ltd. Meerut
10. Sharma, B. K. and Kaur, H. (1990) Environmental Chemistry, Goel Publishing House, New Delhi
11. Sodhi, G. S. (2006) Fundamental concepts of environmental Chemistry, Narosa Publishing House, New Delhi

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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 andHM), 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

1. Balagurusamy, E. (1995) Programming with C., Tata McGraw Hill Pub., New Delhi.
2. Gupta, S. C. (1999) Fundamentals of Statistics, Himalayan Pub. House New Delhi
3. Hoshmand, A. R. (1988) Statistical methods for Env. and Agr. Science. CRS Press, New York
4. Jain, P. K. (1995) Fundamentals of Computers, BPB Pub., New Delhi.
5. Kanetkar, Y. (1998) Exploring in C., BPB Pub., New Delhi.
6. Khan, I.A. and Khanum, A. (1994) Biostatistics, Ukaaz Publications, Hyderabad
7. Rajaraman, I. (1989) Fundamentals of Computers, PHI Pub., New Delhi.
8. Rao, P. S. S. and Richard, J. (1996) An Introduction to Biostatistics. Prentice Hall, New Delhi
9. Sharma, A. K. (1996) Computer Science, Dhanpat Raiand Sons, New Delhi.
10. Sinha S. C. and Dhiman, A. K. (2002) Research Methodology (2 Vols.-Set), Ess Ess Publications, New Delhi
11. Sinha, P. K. (1995) Computer Fundamentals, BPB Pub., New Delhi
12. Sukhatma, P. I. and Amble, I. N. (1976) Statistical methods for Agricultural workers, ICAR, New Delhi

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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

1. Baird, C. and Cann, M. Environmental Chemistry. W.H. Freeman and Company 2008.
2. Chatwal, G. R., and Anand, S. K. Instrumental Methods of Chemical Analysis. Himalaya Publishing House, Delhi. 2007.
3. De, A.K. Environmental Chemistry, New Age International, New Delhi. 2000.
4. Keith, L. H. Principles of Environmental Sampling. American Chemical Society.1988.
5. Murphy, W.J. Analytical Chemistry, American Chemical Society, USA. 1977
6. Reeve, R. Introduction to Environmental Analysis. John Willey and Sns.2002.
7. Shukla, S. K. and Srivastava, P. R. Methodology of Environmental monitoring and Assessment. Commonwealth Publishers.1992.

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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	15 Marks
2.	Viva-voce	5 Marks
	Total	**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	10 Marks
2.	Report on field visit	5 Marks
3.	Viva-voce	5 Marks
	Total	**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	5Marks
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

COURSE NO.	TITLE OF COURSE	Marks		
FOURTH SEMESTER		**Theory**	**Internal Assessment**	**Total**
MES–401	Environmental Law, Governance, Ethics And Policy (Compulsory paper)	80	20	100
MES–402 (i)	Special Paper I: Biodiversity and Wildlife Ecology (Optional paper)	80	20	100
MES–402 (ii)	Special Paper II: Environment Economics (Optional paper)	80	20	100
MES–402 (iii)	Special Paper III: Environmental Health (Optional paper)	80	20	100
MES–402 (iv)	Environmental Biology (Optional paper)	80	20	100
MES–402 (v)	Climate Change and Clean Technology (Optional paper)	80	20	100
MES–402 (vi)	Environmental Clearance and Environmental Audit (Optional paper)	80	20	100
MES–402 (vii)	Principles of Climatology (Optional paper)	80	20	100
MES–403	Dissertation	100	-	100
Total				**300**
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)**				

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

1. Diwan, P. (1997) Environmental Administration - Law and Judicial Attitude, Vol. I, II. Deep and Deep Pub. New Delhi.
2. Divan, S. and Roscencranj, A. (2001) Environmental Law and Policy in India, Oxford Pub. New Delhi
3. Lal, S. (1990) Commentaries on Water, Air pollution and Environment (protection) Law, Law Pub. Pvt. Ltd. India.
4. Leelakrishnan, P. (1999) Environmental Law in India. Butterworths Publications, New Delhi
5. Singh, G. (1995) Environmental Law: International and National Perspectives

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MES-402 (i): SPECIAL PAPER: BIODIVERSITY AND WILDLIFE ECOLOGY (OPTIONAL)

MODULE-1 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

MODULE-2 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

MODULE-3 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

MODULE-4 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

MODULE-5 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

1. Berwick, S.H. and Sharma, V.B. (1995) Wildlife Research and Management, Oxford Univ. Press, Delhi.
2. Champion, H. C. and Sheth, S.K. (1968) A revised Survey of the Forest Types of India, Pub. Manager, Col. Press- Nasik /Manager of Publication Delhi
3. Dassman, R.F. (1982). Wildlife Biology (II Ed.), Wiley Eastern Ltd., New Delhi
4. Giles, R.H. (1984) Wildlife Management Techniques, The Wildlife Society, Washington, D.C.
5. Leopld, A. (1933) Game Management, Charles Scribner's Sons, New York, London
6. Odum, E.P. (1971) Fundamentals of Ecology, W.B. Saunder Co. / Toppan Co. Ltd.

7. Prater, S.H. (1980) The Book on Indian Animals, BNHS, Bombay
8. Schaller, G. B. (1987) The Dear and the Tiger, ZSI, Calcutta
9. Sparke, J. (1970) Bird Behaviour, Govosset and Dulop, Inc. New York
10. Stoddart, A. I. (1975) Range Management, Pub. McGraw Hill, Col. Inc. New York
11. Teague, R. D. (1971) A manual of Wildlife Conservation, Pub. The Wildlife Society, Washington, D.C.
12. Tikader, B. K. (1983) Threatened Animals of India, ZSI, Calcutta

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MES-402 (ii): SPECIAL PAPER: ENVIRONMENT ECONOMICS (OPTIONAL)

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

1.2 Economics of Natural Resource Exploitation – Renewable and Non-Renewable Resources – Methods of valuation of Environmental Costs and Benefits. Entropy-Principle and law of entropy. Material flow in economy.

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

4.1 New model for development, Green economy and green economy initiatives, Role of UNEP. Brundtland Commission. Ecological economics Economic Growth and the Environment: Environmental Kuznets' curve, Foreign Direct Investment and the Environmental quality.

SUGGESTED READINGS

1. Allen V. Kneese and James L. Sweeney, eds. Handbook of Natural Resource and Energy Economics, Chapters 2,12,14,17, North Holland, 1985.
2. Bohm, P. and Russell, C., Comparative Analysis of Alternative Policy Instruments', Chap. 10 in Handbook of Natural Resource and Energy Economics, Vol. I Ed. A.V.
3. Field, B.C., Environmental Economics: An Introduction, McGraw Hill, 1994
4. Fisher, A.C., Environment and Resource Economics, Selected readings, New Horizon in Environmental Economics, Ed. W.E. Oates, 1995.
5. Hanley, Nick, Jason F. Shogren and Ben White: Environmental Economics in Theory and Practice, New Delhi: Macmillan –India, 1997.
6. James, D.E., Economic Approaches to Environmental Problems: Techniques and Results of Empirical Analysis, Elsevier Scientific Publishing Co., 1978.
7. Kolstad Charles., Environmental Economics, New Delhi: Oxford University Press,2010 14
8. Mehta, S., S. Mundle and U. Sankar, `Incentives and Regulation for Pollution Control', Sage, 1997.
9. Oates, W.E., Economics of the Environment, 1992.
10. Sankar, U. (ed.) Environmental Economics, New Delhi: Oxford University Press, 2001.

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MES-402 (iii): SPECIAL PAPER: ENVIRONMENTAL HEALTH (OPTIONAL)

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

1. Goel, S. L. (2008) Environment Health and Value Education. Deep and Deep Publications
2. Kumar, H. (2001) Environmental Health Hazards. IVY Publishing
3. Sarkar, A and Panigrah, S. K. (2007) Water Borne diseases in India: Environmental health and policy perspective. Manak
4. Yassi, A. (2001). Basic Environmental Health, Volume I. Oxford University Press
5. Sarkar, A., Panigrah, S. K. and Anand, M. (2007) Vector Borne diseases in India: Environmental health and policy perspective. Manak
6. Benjamin O. Alli. (2008) Fundamental Principles of Occupational Health and Safety. International Labour Office, Geneva

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MES-402 (iv): SPECIAL PAPER: ENVIRONMENTAL BIOLOGY (OPTIONAL)

MODULE-1 BIOSPHERE AND ITS EVOLUTION

1.1 Evolution of earth's atmosphere, evolution of secondary atmosphere (biochemical pathways and evolution of atmosphere), carbonate precipitation, photosynthesis and cellular respiration and carbon sequestration.

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

1. A.L. Bhatia (2010). Textbook of Environmental Biology. I. K. International Publishing house.
2. C. Barry, Cox and Peter, D. Moore (2010). Biogeography: An Ecological and evolutionary approach. Paperback
3. Mathur, H.S. (2003). Essentials of Biogeography. Pointer
4. Mehtani, S. and Sinha, A. (2010). Biogeography. Commonwealth
5. Purohit, S. S. and Mathur, S.K. (1996) Biotechnology Fundamentals and Applications. Agrobotanical Publication, New Delhi
6. Yadav, P.R. (2003). Environmental Biology. Discovery Publishing House.

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MES-402 (v): SPECIAL PAPER: CLIMATE CHANGE AND CLEAN TECHNOLOGY

MODULE-1 SCIENCE OF CLIMATE CHANGE

1.1 Drivers of climate change- greenhouse gases, aerosols – reflective and black carbon, land use changes. Energy balance, feed-back processes in climate system, concepts of global warming potential (GWP), radioactive forcing.

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

1. Botkin, Daniel B. and Keller, Edward A. Environmental Science: Earth as a Living Planet. 6th ed. John Wiley and Sons, USA. 2007.
2. Burroughs, W.J. Climate Change: A Multidisciplinary Approach. 2nd ed. Cambridge University Press. 2007.
3. Chasek, P. S. The Global Environment in the Twenty-First Century - Prospects for International Co-operation. Indian Reprint by Manas Publications, New Delhi. 2004.
4. Claussen, E. ed. Climate Change: Scenario, Strategies and Solutions. Arlington VA. 2001.
5. Dash, S. K. Climate Change-An Indian Perspective. Centre for Environment Education and Cambridge University Press Pvt. Ltd., New Delhi. 2007.
6. Dodds, F. (Ed.). Earth Summit. 2002. A New Deal. Earthscan Publications Ltd., UK. 2002.
7. Enger, E.D. and Smith, B. F. Environmental Science: A Study of Interrelationships. 11th ed. McGraw Hill Inc., USA. 2006.
8. Hardy, John T. Climate Change: Causes, Effects, Solutions. Wiley and Sons, USA. 2003.
9. Harris, F. Global Environmental Issues. Wiley and Sons, Inc., USA. 2004.
10. Harvey L. D. D. Global Warming: The Hard Science. NY: Prentice-Hall.2000.
11. IPCC, Emission Scenarios, Inter Governmental Panel on Climate Change, Cambridge University Press, 2000.
12. Silver C. S. and DeFries, R. S. One Earth one Future: - Our Changing Global Environment. East-West Press Edition, 1991.
13. Singh, J.S., Singh, S.P. and Gupta, S.R. Ecology, Environment and Resource Conservation. Anamaya Publishers, New Delhi, India. 2006.
14. Speth, J. C. Global Environmental Challenges – Transitions to a Sustainable World. Orient Longman Pvt. Ltd., New Delhi. 2004.

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MES-402 (vi): SPECIAL PAPER: ENVIRONMENTAL CLEARANCE AND ENVIRONMENTAL AUDIT

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

3.1 Generic structure of environmental impact assessment document – Executive summary of Project, Introduction, Project description, Project benefits, Policy legal and administrative framework, EIA methodology, Description of Environment, prediction of environmental impacts, evaluation of impacts, Environmental impact statement (EIS), Impact evaluation, Environmental Management Plan (EMP), Disclosure of Consultants engaged.

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

1. Bose, S. and Parekh, A. The Environment Audit:-Holy Grail or Essential Management Tool. The Management Accountant.1994.
2. Corello, V. T., Mumpower, J. L., Stallen, P. J. M., Uppuluri, V. R. R. Environmental Impact Assessment, Technology assessment and Risk Analysis. Springer-Verlag Berlin Heidelberg.1985.
3. Glasson, J. Therivel, R. and Chadwick, A.. Introduction to Environmental Impact Assessment. Routledge, London. 2006
4. GOI – Ministry of MoEF Gazette Notification under sub-rule (3) of Rule 5 of Environment (Protection) Rules. 2006.
5. Morris, P. and Therivel R. (Eds) Methods of Environmental Impact Assessment. 2nd Edition, Spon Press London. 2001.
6. Petts, J. Handbook of Environmental Impact Assessment- Volume 1 and 2. Blackwell Publishers, UK 2005.
7. Rajaraman, N. Environment Audit. The Management Accountant.1997.
8. Rao, P. S. and Rao, P. M. Environmental Management and Audit. Deep and Deep Publications.2000.
9. Raymond, A. B. and Fenn, D. H. The Corporate Social Audit. Russell Sage Foundation New York.1992.
10. Timothy O. R. Environmental Impact Analysis and Risk Assessment in a Management

Perspective. Goodman and Rowe.1979.

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

1. Cunningham, W.P. and Saigo, B.W.(1999) Environmental Science - A Global Concern WCB MC Graw- Hill, U.S.A.
2. Emiliani, C. (1992) Planet Earth. Cambridge University Press, U.K.
3. Fellmann, J., Getis, A. and Getis, J. (1996) Human Geography-Landscapes of Human activities, WCB McGraw-Hill, USA.
4. Houghton, J. (1997) Global Warming - The complete Briefing. Cambridge Univ. Press, U.K.
5. Lean, G. and Hinrichsen, D. (1994) Atlas of the Environment. Harper Perennial Pub., New York.
6. Lundgren, L. (1986) Environmental Geology. Prentice Hall, New Jersey.
7. Lunine, J. I. (1999) Earth-Evolution of a Habitable World. Cambridge Univ. Press, U.K.
8. McKnight, T.L. (1993) Physical Geography-A Landscape Appreciation. Prentice Hall, New Jersey.
9. Pearce,F. (1989) Climate and Man - From the Ice Ages to the Global Greenhouse. Ivision Books, London.
10. Rogers, J. J. W. and Feiss, P.G. (1998). People and the Earth - Basic Issues in the Sustainability of Resources and Environment. Cambridge University. Press, U.K.
11. Smithson, P., Addison, K. and Atkinson, K. (2002). Fundamentals of the Physical

Environment. Routledge Publishers, London

12. Wellburn, A. (1996). Air Pollution and Climate Change- The Biological Impact. Longman Publishers, Singapore

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.