HIMACHAL PRADESH TECHNICAL UNIVERSITY
HAMIRPUR-177001 (INDIA)

SYLLABUS

FOR

MASTER OF SCIENCE IN ENVIRONMENTAL SCIENCE
(M.Sc. in Environmental Science)

(Two Years Programme)
(Spread Over Four Semesters)

FIRST TO FOURTH SEMESTER
SYLLABUS SCHEME
## M.Sc.-Environmental Science

**FIRST YEAR**  
**SEMESTER-I**

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### FOUNDATION COURSES

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**TOTAL CREDITS**

|         | 20 | - | 4 | 24 | 120 | 120 | 240 | 360 | 600 |

*Skill Development-I:*
(i) Environmental Risk Assessment

**Human Making-I**
(i) Waste Management Techniques

**Legend:**

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M.Sc. -Environmental Science

FIRST YEAR
SEMESTER-I

Max. Marks: 600

Core Courses

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Foundation Courses

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M.Sc.-Environmental Science
Semester-I

CORE COURSES:

EVS-411: INTRODUCTION TO EARTH PROCESSES
Credits: 4
Total Marks: 100
(IA: 40+ESE: 60)
Time-3 Hours

Note:
The question paper for the final examination will consist of five sections- A, B, C, D & E. Section A, B, C, D will have two questions each from the corresponding units I, II, II & IV of the syllabus. Section E in the paper will be compulsory and will have short answer type questions consisting of six parts of two marks each covering the whole syllabus. Each question will be of 12 marks. The candidates will attempt five questions in all, i.e. one question each from the sections A, B, C, D and the compulsory question from section E.

Unit I: Introduction to Earth Science
The role of earth science, Importance of minerals in everyday life, Evolution of various branches of Earth Science, Earth as a dynamic system, Earth, Man and Environment. Introduction to the planetary system, Different theories of origin and evolution of earth, Origin of atmosphere, water and life, Geological time scale, Primary differentiation and multilayer structure of Earth.

Unit II: Rock and Minerals
An overview on different rock types, Different mineral groups: Silicate and Non Silicate, Physical properties of mineral, Mohs hardness scale.

Unit III: Plate Tectonics
The concept of Hypothesis and Theory, Continental Drift hypothesis, Theory of Plate tectonics, Mountain building and sea floor spreading processes, Distribution of earthquake and volcanic activity across the globe.

Unit IV: Oceanography
Hypsography of the continents and ocean floor –continental shelf, slope, rise and abyssal plains, Physical and chemical properties of sea water and their spatial variations, Ocean currents, waves and tides.
Text Books:


Reference Books


EVS -412: ECOLOGY AND ENVIRONMENT

Credits: 4
Total Marks: 100
(IA: 40+ESE: 60)
Time-3 Hours

Note:
The question paper for the final examination will consist of five sections-A, B, C, D&E. Section A, B, C, D will have two questions each from the corresponding units I, II, III&IV of the syllabus. Section E in the paper will be compulsory and will have short answer type questions consisting of six parts of two marks each covering the whole syllabus. Each question will be of 12 marks. The candidates will attempt five questions in all, i.e. one question each from the sections A, B, C, D and the compulsory question from section E.

UNIT I
Scope and Introduction: Subdivisions, major landmarks in Ecology, levels of organization hierarchy; Organisms and Environment-Holocoenotic nature of environment; biotic and abiotic components. Population characteristics-Population Size and Density, Dispersion, Age structure, Natality, Mortality and Life Tables; population dynamics and concept of carrying capacity; Regulation of population growth.

UNIT II
Community Ecology: Community concept and brief classification, community characteristic, characters used to describe community structure- analytical, qualitative and synthetic characters, methods of community studies, species diversity α, β and γ); concept of ecological niche- types, ecotone & edge effect.

UNIT III
Community Development: Ecological succession-concept, causes and trends; Basic types of succession, General process of succession, Hydrosere, Lithosere, Heterotrophic succession, Ecosystem Development, concept of climax, Biome.

UNIT IV
Ecosystem Organization and Management: Concept of Ecosystem, Trophic structure of ecosystem, Examples of Ecosystem-A pond and an Old field or grassland ecosystem, Ecological pyramids-Pyramids of number, biomass and energy, Productivity of Ecosystem- Primary, Secondary and Net Productivity, Grazing and detritus food chains, Food web, Energy flow in ecosystem (simplified energy flow diagram depicting three trophic levels in a linear food chain), Biodiversity hot spots-Concept, brief introduction to biodiversity hot spots of India.
Text Books:


EVS- 413: ENVIRONMENTAL CHEMISTRY

Note:
The question paper for the final examination will consist of five sections-A, B, C, D&E. Section A, B, C, D will have two questions each from the corresponding units I, II, III&IV of the syllabus. Section E in the paper will be compulsory and will have short answer type questions consisting of six parts of two marks each covering the whole syllabus. Each question will be of 12 marks. The candidates will attempt five questions in all, i.e. one question each from the sections A, B, C, D and the compulsory question from section E.

UNIT I
Stochiometry, Gibbs’ energy, chemical Potential, chemical equilibrium acid base reactions, Solubility product, solubility of gases in water, the carbonate system, Unsaturated and saturated hydrocarbons, radio nuclides.

UNIT II
Chemical compositions of Air: Classification of elements, chemical speciation, Particles, Ions and radicals in atmosphere, chemical processes for formation of inorganic and organic particulate matter, thermo chemical and photochemical reaction in atmosphere Oxygen and Ozone chemistry, chemistry of air pollutants, photochemical smog.

UNIT III

UNIT IV
Main and transition metals Chemistry, Metal- Ligand concept and its implication towards biochemistry of metals.

Prescribed Text Books:

4. **Siegfried Hubener, Encyclopedia of Inorganic Chemistry**  

**Suggested Additional Readings:**

1. **Jayaraman, J., Laboratory Manual in Biochemistry, New Age International (P) Limited.**
2. **Puri Sharma & Kalia, Principles of Inorganic Chemistry, S. Chand and company, N Delhi.**
3. **Keith Bucher, Global Climate, Wiley, New York 1976.**
5. **Levin, Aerosol pollution impact on precipitation. New York Springer, 2009.**
8. **Marcos, Ron and Biological waste water treatment in warm climate regions. London: IWA, 2006.**
9. **Rogers, J. Environment and water resources. USA: ASCE, 2007.**
10. **Manahan, Stanley Environmental chemistry. Boca Raton: CRC, 2010.**
11. **O’neill, Environmental chemistry. -- London: Blackie, 2009.**
12. **Srivastava, Manish Environmental chemistry. -- Delhi: Sree, 2009.**
UNIT I

Introduction to Natural Resource Bases, Concept of resource, classification of natural resources, Factors influencing resource availability, distribution and uses, Need for Conservation of Natural Resources, Current status of natural resources.

UNIT II


UNIT III

Biological Resources, threat to biodiversity, conservation of biodiversity, Energy, Types of energy resources, conventional and non conventional source of energy, bio fuel and its advantages, Human Resource.

UNIT IV


TEXT BOOKS

EVS 41L-1: ENVIRONMENTAL SCIENCES LABORATORY – I

[4 Credits]

Laboratory experiments based on the theory courses to be taught in Semester-I
FOUNDATION COURSES:

EVS-SD-I: ENVIRONMENTAL RISK ASSESSMENT

Credits: 2
Total Marks: 50
(IA: 20+ESE: 30)
Time: 2 Hours

Note:
The question paper for the final examination will consist of four sections-A, B, C & D. Section A, B & C will have two questions each from the corresponding units I, II & III of the syllabus. Section D in the paper will be compulsory and will have short answer type questions consisting of six parts of one mark each covering the whole syllabus. Each question from section A, B & C will be of 8 marks while section D will be of 6 marks. The candidates will attempt 4 questions in all, i.e. one question each from the sections A, B & C and the compulsory question from section D.

Unit I: Environmental Quality Assessment and Monitoring


Unit II: Environmental Risk Assessment

Concept; Risk evaluation-Hazard identification, exposure and hazard assessment, Environmental Impact Assessment (EIA) .Concept, origin and scope of EIA; EIA in developing countries, Methodology and objectives of EIA; National environmental policy and statutory requirements of EIA, the Environmental Impact Assessment Notification.

Unit III: Environmental Legislations

Wild Life (Protection) Act, 1972, the Environment (Protection) Act, 1986, Biological Diversity Act, 2002

Text Books:


EVS-HM-I: WASTE MANAGEMENT TECHNIQUES

Credits: 2
Total Marks: 50
(IA: 20+ESE: 30)
Time-2 Hours

Note:
The question paper for the final examination will consist of four sections-A, B, C & D. Section A, B & C will have two questions each from the corresponding units I,II &III of the syllabus. Section D in the paper will be compulsory and will have short answer type questions consisting of six parts of one mark each covering the whole syllabus. Each question from section A, B & C will be of 8 marks while section D will be of 6 marks. The candidates will attempt 4 questions in all, i.e. one question each from the sections A, B & C and the compulsory question from section D.

Unit-I: Biodegradable and Non Biodegradable solid waste

Unit-II: Hospital and Pharmaceutical Waste
Classification, Source and generation, Health hazards, Management Techniques

Unit-III: Waste minimization technologies
Reuse/ recycling of different types of waste, Metal recovery from waste using chemical, biological and hybrid techniques

Text Books:


Suggested Additional Readings:

### M.Sc. Environmental Science
#### 2nd Semester

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### Evaluation Scheme

- **Lecture (L)**
- **Tutorial (T)**
- **Practical (P)**
- **Class Test (CT)**
- **Teacher Assessment (TA)**
- **End Semester Examination (ESE)**

### Core Courses

- **EVS-415**: Atmospheric Sciences (60 + 40)
- **EVS-416**: Global Environmental Issues and Environmental Legislation (60 + 40)
- **EVS-417**: Environmental Engineering (60 + 40)
- **EVS-418**: Hydrology and Water Resources (60 + 40)

### Lab Courses

- **EVS-41L-2**: Environment Lab 2 (60 + 40)

### Generic Elective

- **EVS-SD-II**: Skill Development-II (30 + 20)
- **EVS-HM-II**: Human Making-II (30 + 20)

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*Skill Development-II: (i) Remote Sensing and GIS

**Human Making-II: (ii) Basics of Environmental Sciences

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**M.Sc. - Environmental Science**

#### 2nd Semester

Max. Marks: 600
EVS-415: ATMOSPHERIC SCIENCES

M.Sc. Environmental Sciences
2nd Semester
Credits: 4
Total Marks: 100
(IA: 40 + ESE: 60)

Course contents
Unit 1: Vertical Structure and Composition of Atmosphere
Chemical Composition, the State of the Atmosphere, Atmospheric Density and Pressure, Hydrostatic Balance

Unit 2: Atmospheric Thermodynamics
The Ideal Gas Law and First Law of Thermodynamics, Concept of Air Parcel and Lapse Rates, Atmospheric Stability, Mixing Height and Inversion

Unit 3: Atmospheric Energy Balance

Unit 4: Atmospheric Chemistry
Thermo-chemical and Photo-chemical Reactions, Chemistry of Stratosphere, Stratospheric Ozone Depletion, Chemistry of Troposphere, Acid Rain, Atmospheric Aerosols, Atmospheric Trace Gases

Unit 5: Atmospheric Dynamics
Pressure Belts and Winds, Pressure Gradient Force, Coriolis Force, Centrifugal Force, Frication, Global Circulation

Suggested Readings:


Course contents

Unit 1: Environmental Education and Issues
Environmental education, awareness, ethics and global imperatives, Global environmental problems: Ozone depletion, Global warming, Climate change, Desertification and its control, Depletion of Natural resources, Wet land conservation, Water Crises-Conservation of water, Eutrophication and restoration of Lakes, Epidemiological issues.

Unit 2: International Conventions and Protocols

Unit 3: Environmental Constitutional Perspective

Unit 4: Environmental Protection Legislations

Suggested Readings:
EVS-417: ENVIRONMENTAL ENGINEERING

M.Sc. Environmental Sciences  
2nd Semester  
Credits: 4  
Total Marks: 100  
(IA: 40 + ESE: 60)

Course contents

Unit 1: Mass and Energy Transfer  
- Concentrations and other units of measure, Material Balance  
- Thermodynamics, Chemical Equilibrium

Unit 2: Air, Water and Their Impurities  
- Air and the Atmosphere, Water and the Hydrosphere  
- Water Pollutants  
- Air Pollutants

Unit 3: Air Quality Engineering  
- Air Pollutant Emissions and Controls, Pollutant generation by combustion, Motor vehicle emissions  
- Treatment Technologies, Particle control devices, Absorption for gaseous pollutant

Unit 4: Water Quality Engineering  
- Water Quality Regulations and Treatment Systems  
- Physical Treatment Methods  
- Chemical and Physicochemical Treatment Methods  
- Biological Waste Water Treatment

Unit 5: Global Climate Change and Geo-engineering  
- Green House Effect, Radiative Forcing, Global warming Potential  
- Global Energy Balance, Global Warming  
- Climate Change  
- Mitigation Strategies, Geo-engineering

Suggested Reading:


Course contents

Unit 1: Introduction to Hydrology
Introduction: Hydrology, The hydrologic cycle; Structure and properties of water. Hydrogeology of India. Application of isotopes in hydrology. Inventory of Earth’s water, quality and quantity. Limits of cations and anions in portable water including fluoride and arsenic, phosphate, nitrate and heavy metals.

Unit 2: Surface and Groundwater Resources and their Properties

Unit 3: Environmental Influences on water resources
Surface and groundwater resources of arid and semiarid regions, Snowmelt hydrology from glaciers, fluctuations due to urbanization, Evapo-transpiration and tides. Recent development in surface and groundwater resources monitoring and assessing processes. Water logging and soil salinity-conjunctive use of surface water and ground water.

Unit 4: Water resource management
Flood and flood plain management; Water-shed management, water harvesting and artificial recharge to ground water; water pollution and water treatment. Wetland and riparian management; forest management on water resources.

Suggested Readings:


EVS-SD-II: *SKILL DEVELOPMENT-II: (I) REMOTE SENSING AND GIS

M.Sc. Environmental Sciences
2nd Semester
Credits: 2
Total Marks: 50
(IA: 20 + ESE: 30)

Course Content

Unit 1:

Unit 2:
Sensors on the Ground, in the air, in Space, Satellite Characteristics, Pixel Size and Scale, Different Resolutions, Cameras and Aerial Photography, Different Satellites, Other Sensors

Unit 3:
Radar Basic, Viewing Geometry & Spatial Resolution, Airborne vs Spaceborne Radars, Airborne & Spaceborne Radar Systems

Unit 4:
Image Analysis: Visual interpretation, Digital processing, Preprocessing, Enhancement, Transformations, Classification, Integration

Unit 5:
Applications: Agriculture, Glaciology, Forestry, Geology, Hydrology, Sea Ice, Land Cover, Biomass Mapping, Oceans & Coastal

Suggested Readings:


EVS-HM-II: **HUMAN MAKING-II: (II) BASICS OF ENVIRONMENTAL SCIENCES

M.Sc. Environmental Sciences
2nd Semester
Credits: 2
Total Marks: 50
(IA: 20 + ESE: 30)

Course Content

Unit 1

Unit 2
Atmosphere, Hydrosphere, Lithosphere and Biosphere - Definition, Structure and composition; Structure of Environment.

Unit 3
Green House Effect - Greenhouse gases its sources, impacts, consequences and remedial measures; global warming. Global Climate change, World and Indian scenario, Acid Rain; Brown Haze, Photochemical smog, nuclear winter; Ozone depletion.

Unit 4
Bhopal gas tragedy, Fukushima and Chernobyl disaster, Love Canal tragedy, Minimata Accident, Creation of UNEP and its role, World earth summits; Agenda 21, UNFCCC, Convention on Biodiversity and Convention on Climate Change, CoPs, Climate Change and Global Warming; IPCC and its reports

Suggested reading

Bhatt, S. (2004). Environment protection and sustainable development. APH Publisher
### M.Sc. Environmental Science
#### 3rd Semester

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<th>Sr. No.</th>
<th>Subject Code</th>
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*Interdisciplinary and Applied Sciences-I (Choose any one)
(A) Biodiversity Conservation and Management
(B) Basic of computer Application and Environmental Statistics
(C) Intellectual Property Rights

### M.Sc. - Environmental Science
#### 3rd Semester

Max. Marks: 600

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<th>Core Courses</th>
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**Interdisciplinary elective**

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<tbody>
<tr>
<td>EVS-41 ID-I: *Interdisciplinary and Applied Sciences-I</td>
<td>60 + 40</td>
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</table>
Course contents

Unit 1: Introduction to Glaciology
Glacier systems- Structure and morphology of glaciers- Classification and types of glaciers, Crevasses and icefall, moraines, criques, dead ice. Transformation of snow in to ice, Zones in glacier, areal distribution of glaciers/snow cover and factors controlling the distribution of snow cover.

Unit 2: Paleoglaciation and Glacier landforms
Milankovitch cycles and Greenhouse effect, Little ice age (LIA), Glacial and interglacial cycles, Depositional and erosional Glacial landforms, Avalanches, Surging glaciers, tide water glaciers, Permafrost, Ice sheets, Ice stream and ice shelves.

Unit 3: Glacier Mass Balance
Mass balance- Glacier dynamics, Englacial and subglacial process and fluctuations- Stake method, Geodetic method, ELA, AAR methods, Glacier hydrology methods, Snow and melt water chemistry of Glaciers.

Unit 4: Approaches to Glaciology
Approaches to Glaciology- Glacier modeling, Glacier and climate change impact, Glacier and water resources, Recent advances in Glaciology, Glacier Hazards, Glaciers as tool for palaeo climate studies.

Suggested Readings:


EVS-420: ENVIRONMENTAL IMPACT ANALYSIS

M.Sc. Environmental Sciences  
3rd Semester  
Credits: 4  
Total Marks: 100  
(IA: 40 + ESE: 60)

Course contents

Unit 1: Introduction to EIA and Environmental Planning
Origin, aims and needs of EIA, EIA guidelines 1994, EIA notification and amendments; Environmental Impact Assessment (EIA) as a tool in environmental management, EMS, ISO 14001. Baseline information and predictions (Land, water, atmosphere, energy etc.), Restoration and rehabilitation technologies.

Unit 2: EIA Methodology
Types of Projects requiring Environmental Clearance, Types of EIA, Project screening, Scoping, Base-line study, Impact identification, Prediction and assessment of impacts, Mitigation measures. Public participation, review and decision making, Generic structure of EIA Document, Composition of EAC, SEAC, Benefits and future of EIA.

Unit III: Environmental Audit
Introduction, concepts, steps, methodology. Environmental Auditing: Procedure, Matrix methods and Batelle method of auditing, National Environmental Policies and guidelines for environmental audit in India, Environmental impact statement

Unit IV: Case Studies
Environmental Impact Assessment of major developmental projects – river valley projects, mining projects, thermal power plants, transport (rail, road highway), oil refineries and petrochemicals. Prediction and assessment of impacts on the biological, cultural and socio-economic environments

Suggested Readings:


EVS-421: NATURAL HAZARDS AND DISASTER MANAGEMENT

M.Sc. Environmental Sciences
3rd Semester

Credits: 4
Total Marks: 100
(IA: 40 + ESE: 60)

Course contents

Unit 1: Introduction to Hazards
Hazard Classification – Natural hazards and Technological hazards, Effects of hazards, Vulnerability and susceptibility of hazards, Assessing hazards and risks, Hazard prediction and warning, A brief introduction to biological hazards- Biological warfare, Anthrax.

Unit 2: Earthquakes, Landslides and Volcanoes
Earthquakes - Types and Distribution of earthquakes, Prediction and control of earthquakes, Tsunami, mass movements; types, affecting factors, prediction, prevention & control and effect of mass movements. Volcanoes-Distribution, types, eruption processes, Factors, Products.

Unit 3: Water related hazards
Different kinds of floods, Factors leading to floods, Factors affecting floods, Floods and their associated hazards, Flood control measures, Prediction of floods. Factors leading to drought, drought consequences, strategies for drought mitigation, Desertification – Factors causing desertification, famine, El Nino and their effects.

Unit 4: Weather related Hazards

Suggested Readings:
EVS-422: SOLID AND HAZARDOUS WASTE MANAGEMENT

M.Sc. Environmental Sciences  
3rd Semester  
Credits: 4  
Total Marks: 100  
(IA: 40 + ESE: 60)

Course contents

Unit 1: Introduction to Solid and Hazardous waste
Solid wastes: Definition, types, sources, characteristics, and impact on environmental health.  
Hazardous wastes: Definition, sources and characteristics, Hazardous waste categorization.

Unit 2: Handling and Legislation of Waste
Handling of Solid and Hazardous waste: Collection, segregation and transport of solid wastes at source, Collection, storage, segregation and transport of Hazardous waste, Legislation on management and handling of municipal solid wastes and hazardous wastes.

Unit 3: Waste minimization techniques

Unit 4: Landfills: Disposal/Treatment of wastes
Disposal in landfills: site selection, design, and operation of sanitary landfills; secure landfills and landfill bioreactors; leachate and landfill gas management; landfill closure and post-closure environmental monitoring; landfill remediation.

Suggested Readings:


Course Content

Unit 1: Introduction to biodiversity
Ecosystems, Biomes, Biodiversity hotspots and their characteristic flora and fauna; Economic value of biodiversity. Levels of Biodiversity: Community diversity (alpha, beta and gamma biodiversity), Gradients of Biodiversity (latitudinal, insular), Ecosystems diversity: biomes, mangroves, coral reefs, wetlands and terrestrial diversity (equilibrium mix of $G$ and $W$). Microbial diversity, Plant diversity, Agro biodiversity.

Unit 2: Biodiversity magnitude and distribution
Species diversity: richness and evenness, loss of species. Magnitude of biodiversity (Global and Indian data). Direct and indirect benefits, Bioprospecting; Genetic diversity; Mapping of biodiversity.

Unit 3: Threats to biodiversity
Threats to Biodiversity: Habitat loss and fragmentation; Disturbance and pollution; introduction of exotic species; extinction of species; Threatened plants and animals of India. IUCN threat categories, Red data book, Invasions- causes and effect.

Unit 4: Wildlife and its management
Significance of wildlife, Important wildlife species in different sub regions of India, Endangered Plant species of Himalayas, Causes of wildlife resource depletion in India, Important National Parks, Wildlife Sanctuaries and Biosphere reserves in India.

Unit 5: Conservation of biodiversity
Principles and strategies; in-situ and ex-situ conservation, Protected Area Network.

Suggested Readings:


EVS-41 ID-I (B): BASIC OF COMPUTER APPLICATION AND ENVIRONMENTAL STATISTICS

M.Sc. Environmental Sciences
3rd Semester

Credits: 4
Total Marks: 100
(IA: 40 + ESE: 60)

Course Content

Unit 1

Unit 2
Sharing Data over Network, Computer Configuration, Memory Hierarchy, Software Structure. Introduction to MS Paint, Notepad and Word.

Unit 3

Unit 4
Spreadsheet applications, Presentation applications, Internet browsers and Image processing applications, Measures of central tendency - mean, mode and median; dispersion (including box and whisker plot), skewness and kurtosis., Probability, combinatorial problems, conditional probability, Binomial Distribution. Linear regression and correlation (Karl Pearson’s and Spearman’s) and residual plots; curve fitting; Hypothesis testing, t-test, z-test, $\chi^2$ test.

Suggested Reading


Course Content

Unit 1 Introduction
Introduction to IPRs, Basic concepts and need for Intellectual Property – Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO – TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

Unit 2 Registration of IPRs
Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

Unit 3 Agreements and Legislations

Unit 4 Digital Products and Law

Suggested Reading:


S. V. Satakar, —Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002
# M.Sc. Environmental Science
## 4th Semester

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<th>Sr. No.</th>
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**TOTAL CREDITS** 16+4 20 100 100 200 300 500

**Discipline Specific Elective-I**
- A. Ecotoxicology and Occupational Safety
- B. Introduction to Research Methodology
- C. Biodiversity and Conservation Biology

**Discipline Specific Elective-II**
- (A) Environmental Analytical Techniques
- (B) Soil Biology
- (C) Environment Pollution and Control

# M.Sc. Environmental Science
## 4th Semester

Max. Marks: 600

**Core Courses**
- EVS-423: Meteorology and Climatology 60 + 40
- EVS-424: Energy and Environment 60 + 40
- EVS-425: Discipline Specific Elective-I 60 + 40
- EVS-426: Discipline Specific Elective-II 60 + 40

**PROJECT WORK/ Dissertation**
- EVS-001: Dissertation (Field / Lab Work, Research, Report and Viva Voce) 100
Course contents

Unit 1: Introduction to Meteorology fundamentals
Thermal structure of the atmosphere and its composition, Pressure, temperature, wind and wind belts, humidity, virtual temperature, radiation, radiation from sun, solar constant, albedo, emission and absorption of terrestrial radiation, greenhouse effect, net radiation budget.

Unit 2: Atmospheric Air Dynamics
Atmospheric stability diagrams, turbulence, diffusion, thermodynamic diagrams, T-phigram and mixing height, thermodynamics of dry and moist air, specific gas constant, adiabatic and isoentropic processes, entropy and enthalpy, adiabatic processes of moist air.

Unit 3: Climatology Fundamentals
Classification of climate- Koppen's and Thornthwaite' scheme, Climatic types and their distribution, cloud formation and precipitation, fronts: frontogenesis and frontolysis, Air masses.

Unit 4: Atmospheric Disturbances
Monsoon, jet stream, cyclones and anticyclones, tropical disturbances: Hurricanes, Thunderstorms, Tornadoes, Applied climatology.

Suggested Reading:


EVS-424: ENERGY AND ENVIRONMENT

M.Sc. Environmental Sciences
4th Semester

Credits: 4
Total Marks: 100
(IA: 40 + ESE: 60)

Course contents

Unit 1: Introduction
Introduction to energy sources, Energy scenario in world and India, Potential and perspectives of various energy sources in India, classification of energy resources-conventional and non-conventional, renewable and nonrenewable, environmental implications of energy resources.

Unit 2: Conventional energy
Fossil fuels (Coal, petroleum, LPG and natural gas) – origin, composition and physico chemical characteristics and energy content, sources properties and production process; nuclear energy– fission and fusion, technologies – nuclear enrichment, nuclear reactors, nuclear waste disposal, policies and regulations.

Unit 3: Non-Conventional energy

Unit 4: Waste to Energy and Energy Conservation

Suggested Reading:
EVS-425 (A): ECOTOXICOLOGY AND OCCUPATIONAL SAFETY

M.Sc. Environmental Sciences  
4th Semester  
Credits: 4  
Total Marks: 100  
(IA: 40 + ESE: 60)

Course contents

Unit 1 Ecotoxicology
Ecotoxicology as a Synthetic Science; Major classes of Environmental Pollutants; Inorganic, Heavy Metals, Organics, Organometalics, Radioactive Isotopes, Gases Routes of Entry into Ecosystems – Surface waters, Land, Atmosphere; Long-range movement and global transport of pollutants. Fate of pollutants in Ecosystems: Biotransformation, Bioaccumulation & Biomagnification.

Unit 2 Analysis methods
Test organisms used in Bioassays. Biomonitoring: Definition of toxicity, F, As, Hg problems Toxicity Testing, Concept of Dosimetry: lethal, sub-lethal & chronic tests, dose response curves, LC50, MATC-NOEC, Brief statistical methodology Toxicant Effects: - Cellular, organismic, population & Ecosystem-Level Effects; Global Effects – Acid rain etc.

Unit 3 Environmental Health
Toxicology & Epidemiology and occupational health Sources: Solid & Hazardous wastes, untreated sewage, Automobile exhausts, Industrial Effluents, Industrial emissions into atmosphere, Agricultural run-off of Pesticides

Unit 4 Environmental Issues
Environmental Carcinogens, Mutagens, Asbestos issues Human adaptation to cold and hot climates, high altitude environment and man-made environments. Water pollution – Caused diseases (Gastroenteritis, Hepatitis etc.). Air pollution caused diseases (allergies, respiratory diseases). Food-borne diseases (Food poisoning, parasites etc). Vector transmitted diseases. Radioactive effects. Risk assessment

Suggested readings:


EVS-425(B): INTRODUCTION TO RESEARCH METHODOLOGY

M.Sc. Environmental Sciences
4th Semester

Credits: 4
Total Marks: 100
(IA: 40 + ESE: 60)

Course contents

Unit 1 - Introduction to Research
Meaning of research; Types of research- Exploratory research, Conclusive research; The process of research; Research applications in social and business sciences; Features of a Good research study.

Unit 2 - Research Problem and Formulation of Research Hypotheses
Defining the Research problem; Management Decision Problem vs Management Research Problem; Problem identification process; Components of the research problem; Formulating the research hypothesis- Types of Research hypothesis; Writing a research proposal- Contents of a research proposal and types of research proposals.

Unit 3 - Research Design

Unit 4 - Primary and Secondary Data
Classification of Data; Secondary Data: Uses, Advantages, Disadvantages, Types and sources; Primary Data Collection: Observation method, Focus Group Discussion, Personal Interview method.

Suggested Reading:


EVS-425 (C): BIODIVERSITY AND CONSERVATION BIOLOGY

M.Sc. Environmental Sciences               Credits: 4
4th Semester                        Total Marks: 100
                                          (IA: 40 + ESE: 60)

Course contents

Unit 1: Concept of Biodiversity
Concept of biodiversity, Levels of Biodiversity: Community diversity (alpha, beta and gamma biodiversity), Ecosystems and Ecosystems diversity: biomes, mangroves, coral reefs, wetlands and terrestrial diversity, Species diversity: richness and evenness, Genetic diversity.

Unit 2: Threats to Biodiversity
Threats to Biodiversity: Habitat loss and fragmentation; Disturbance and pollution; introduction of exotic species; extinction of species. Human intervention and Biodiversity loss: Global Environmental changes, land in water use changes.

Unit 3: Biological Conservation

Unit 4: Benefits of Biological Conservation
Benefits of conservation: Biodiversity as a source of food and improved varieties; source of drugs and medicines; Aesthetics and cultural benefits. Sustainable development. Ecosystems services: maintenance of gaseous composition of the atmosphere, climate control by forests, pollination of plants by insects and birds, formation and protection of soil, conservation and purification of water.

Suggested Reading:


EVS-426 (A): ENVIRONMENTAL ANALYTICAL TECHNIQUES

M.Sc. Environmental Sciences
4th Semester

Credits: 4
Total Marks: 100
(IA: 40 + ESE: 60)

Course contents

Unit 1: Introduction to Chromatography
Basic principle of Analytical techniques. Different types of Chromatography techniques and their applications. Thin layer Chromatography – Basic principle, methodology, application.

Unit 2: High Performance Liquid Chromatography
Basic Principle, Methodology, Application. Discussion with examples based on published research papers.

Unit 3: Gas Chromatography
Basic Principle, Methodology, Application. Discussion with examples based on published research papers.

Unit 4: Liquid and Gas Chromatography - Mass spectrometry
Basic Principle, Methodology, Application. Discussion with examples based on published research papers.

Suggested readings:
Handbook of HPLC. Danilo Corradini, Elena Eksteen (Katz), Roy Eksteen, Peter Schoenmakers, Neil Miller. CRC Press.
[http://books.google.co.in/books/about/Handbook_of_HPLC.html?id=4mj_DArD5n0C]

[http://www.lcresources.com/resources/resbooks.html]
Course contents

Unit 1:

Unit 2:

Unit 3:

Unit 4:
Environmental problems related to soils in India: desertification, salinization, erosion. Bioremediation of contaminated soils and ground water, Fate of plant allelochemicals in soil, Composting, a value addition to our wastes.

Suggested Readings:


Alexander, M., 1994, Biodegradation and Bioremediation, Academic Press. 28


Course contents

Unit 1: Waste water management
Primary treatment methods—screening, grit removal, primary sedimentation, secondary treatment methods, activated sludge process, Trickling filters, Rotating biological contactors, Oxidation ponds and Lagoons. Advance waste water treatment, removal of nutrients and solids. Wastewaters reuse and sludge disposal, MINAS

Unit 2: Air Pollution control

Unit 3: Noise Pollution Control

Unit 4: Solid and Hazardous Waste Management

Suggested Readings:


