

M.Sc. Environmental Science

SYLLABUS BASED ON THE SEMESTER SYSTEM

ELIGIBILITY REQUIREMENTS

Candidates who have passed B.Sc. (Hons.)/B.Sc. (10+2+3) with a minimum of 50% marks or equivalent GPA (also a minimum 50% aggregate or equivalent GPA at 10 & 10+2 levels) shall be considered eligible for admission to M.Sc. Course in Environmental Science.

General Guidelines

1. There shall be four semesters two in each year with total of 80 credits.
2. There shall be 17 core courses of theory papers with total of 40 credits. Lab work based on theory papers will have 17 credits.
3. In the semester III students will select two major elective courses out of four offered.
4. There shall be two minor elective courses based on only theory papers of total 4 credits. The minor course shall be offered to the students of other departments of the Faculty of Science.

M.Sc. ENVIRONMENTAL SCIENCE

Department of Botany, Banaras Hindu University, Varanasi – 221005

DISTRIBUTION OF DIFFERENT COURSES AND CREDITS IN VARIOUS SEMESTERS

| SEMESTER – I | | |
|-----------------------|---|-----------|
| Courses | Course Title | Credits |
| ESM – 101 | Foundation Course in Ecology | 3 |
| ESM – 102 | Earth and its Atmosphere | 3 |
| ESM – 103 | Aquatic Environment | 3 |
| ESM – 104 | Environmental Microbiology and Biotechnology | 3 |
| ESM– 105 | Global Environmental Change | 2 |
| ESM – 106 | <i>Lab work based on courses ESM – 101 and ESM – 102</i> | 3 |
| ESM – 107 | <i>Lab work based on courses ESM – 103 and ESM – 104</i> | 3 |
| | Total | 20 |
| SEMESTER – II | | |
| ESM – 201 | Biodiversity and Conservation | 3 |
| ESM – 202 | Energy Resources and Conservation | 3 |
| ESM – 203 | Environmental Pollution and Toxicology | 3 |
| ESM – 204 | Environmental Monitoring and Management | 3 |
| ESM – 205 | <i>Lab work based on courses ESM – 201 and ESM – 202</i> | 3 |
| ESM – 206 | <i>Lab work based on courses ESM – 203 and ESM – 204</i> | 3 |
| ESM – 207 M | Natural Resources and Management -Minor Elective | 2 |
| | Total | 20 |
| SEMESTER – III | | |
| ESM - 301 | Biostatistics and Modeling | 3 |
| ESM – 302 | Water Resource Management | 3 |
| ESM – 303 | <i>Lab work based on courses ESM – 301 and ESM – 302</i> | 3 |
| ESM - 304 | <i>Any one of the following:</i> Ecological Restoration | 3 |
| ESM - 305 | Society and Environment | |
| ESM - 306 | <i>Any one of the following:</i> Air Pollution Control and Abatement | 3 |
| ESM - 307 | Remote Sensing and GIS | |
| ESM – 308 | <i>Lab work based on courses ESM – 306/ESM – 307</i> | 2 |
| ESM 309-M | Environmental Pollution-Minor Elective | 2 |
| | Total | 19 |
| SEMESTER – IV | | |
| ESM – 401 | Disaster Management | 2 |
| ESM – 402 | Environmental Legislation | 3 |
| ESM – 403 | Industrial Training Report** | 4 |
| ESM – 404 | Dissertation based on project work | 10 |
| ESM - 405 | Field Study and Report thereof | 2 |
| | Total | 21 |
| | Grand Total | 80 |

Environmental Science students shall opt Minor Electives from other programmes

**Industrial training of minimum 4 weeks during summer vacation following semester II

SEMESTER – I**ESM - 101: Foundation Course in Ecology**

Organisms and Environment: Holocoenotic nature of environment; abiotic and biotic environment.

Ecological adaptations: Morphological and physiological responses of organisms to temperature and water.

Population ecology: Population characteristics, population growth, carrying capacity, population regulation, life history strategies (*r* and *K* selection), population interactions including Lotka – Volterra model, population differentiation.

Community ecology: Concepts of community and continuum; community attributes; species diversity (α , β and γ); community coefficients; concept of ecological niche.

Community development: Models and mechanisms of ecological succession; changes in ecosystem properties during succession; Concept of climax.

Ecosystem organization: Ecosystem structure and functions, primary production (methods of measurement, global pattern, controlling factors); energy dynamics (trophic organization, energy flow pathways, ecological efficiencies); litter fall and decomposition; mineral cycles in terrestrial and aquatic ecosystems

Ecosystem management: Concepts; sustainable development; sustainability indicators.

Suggested Readings:

1. E.P. Odum and G.W. Barrett. 2005. Fundamentals of Ecology. Cengage Learning India Pvt. Ltd.
2. J.S. Singh, S.P. Singh and S.R. Gupta. 2008. Ecology, Environment & Resource Conservation. Anamaya Publications.

ESM - 102: Earth and its Atmosphere

Weathering and erosion processes; Types and formation of soils and soil profile.

Earthquakes, Volcanoes, Landslides and Floods: and their impact on environment.

Major rock and ore forming minerals: Properties of minerals; Igneous, sedimentary and metamorphic rocks. Impact of mining on environment.

Groundwater: Occurrence; Salt water intrusion; Pollution and management.

Evolution of the earth's atmosphere, composition and thermal stratification, atmosphere and the earth's radiation balance, circulation of atmosphere, atmospheric stability, lapse rates and mixing heights, plume behavior; Gaussian plume model; Photochemistry of nitrogen oxides, oxygen, ozone and chlorides in the atmosphere.

Köppen's climate classification system; General relationship between landscape, biomes and climate.

Suggested Readings:

1. T. R. Oke. 2006. Boundary layer climates. Methuen & Co. Ltd.
2. S. Pal Arya. 2001. Introduction to Micrometeorology. Academic Press.
3. H. R. Byers. 2006. General Meteorology. McGraw-Hill.
4. K. S. Valdiya. 1987. Environmental Geology. Tata McGraw-Hill.
5. J. M. Wallace and P. V. Hobbs. 2006. Atmospheric Science – An introductory survey.

Academic Press.

7. Hamblin. (8th Ed). 2000. Earths Dynamic Systems. Prentice Hall.
8. David Huddart and TimStott. 2010. Earth Environments- Past, Present and Future. Wiley-Blackwell.

ESM – 103: Aquatic Environment

Diversity of aquatic habitats; hydrologic cycle

Aquatic food webs including microbial loop; trophic cascade

Measurement of aquatic primary productivity

Lakes - Origin and classification, ecological zonation, thermal stratification, water circulation, physical and chemical characteristics

Phytoplankton – diversity and models of nutrient-limited growth, paradox of plankton; a general account of zooplankton

A general account of benthic and periphytic communities

Characteristics of running water habitats; river continuum concept

Oceans: Chemistry of seawater, circulation and ecological zonation in sea, marine biota, coral reefs

A general account of estuaries and wetlands

Eutrophication: Causes, consequences and control measures

Suggested Readings:

1. Dobson, M. and Frid, C. 1998. Ecology of Aquatic Systems. Longman.
2. Adams, S.M. (Ed). 2002. Biological Indicators of Aquatic Ecosystem Stress. American Fisheries Society, Bethesda.
3. Talling, J.F. and Lemoalle, J. 1998. Ecological Dynamics of Topical Inland Waters. Cambridge University Press.
4. Wetzel, R.G. and Likens, G.E. 2000. Limnological Analysis. Springer-Verlag.
5. Wetzel, R.G. 2000. Limnology: Lake and River Ecosystems. Academic Press.
6. Dodson, S. 2005. Introduction to Limnology. McGraw-Hill, New York.

ESM – 104: Environmental Microbiology and Biotechnology

Introduction to microorganisms: General characteristics, nutritional types, microbial diversity.

A brief idea of techniques relating to isolation, purification and culture of microorganisms.

Types of interaction between plants and microbes.

Microorganisms and soil fertility.

Microorganisms in extreme environments.

Microbial toxins and environmental hazards.

Brief account of plant diseases and their ecosystem level effects.

Microbes and public health: Brief account of microbial diseases in humans.

Microbially induced corrosions and biofilms.

Bioremediation of organic and inorganic contaminants.

Brief account of restriction enzymes, cloning vectors, DNA ligases, linkers, blotting techniques and gene libraries.

Strategies of recombinant DNA technology and its applications.

Release of genetically engineered microorganisms: safety and environmental risks.

Vermicular and bio-fertilizer technology.

Suggested Readings:

1. Raina M. Maier. 2000. Environmental Microbiology. Academic Press.
2. Pepper, I. and C. P. Gerba. 2004. Environmental Microbiology (2nd Edition). Academic Press.

ESM – 105: Global Environmental Change

Global Environmental change issues.

Stratospheric ozone layer: Evolution of ozone layer; Causes of depletion and consequences; Effects of enhanced UV-B on plants, microbes, animals, human health and materials; Biological action spectra; Global efforts for mitigation ozone layer depletion.

Climate change: Greenhouse effects; Drivers of climate change; Greenhouse gases and their sources; Implications on climate, oceans, agriculture, natural vegetation, wildlife and humans; Effects of increased CO₂ on plants; International efforts on climate change issues.

Atmospheric deposition: Past and present scenario; Causes and consequences of excessive atmospheric deposition of nutrients and trace elements; Eutrophication; Acid rain and its effect on plants, animals, microbes and ecosystems.

Suggested Readings:

1. N. Adger , K. Brown , D. Conway. (Vol. 22). 2012. Global Environmental Change: Understanding the Human Dimensions. The National Academic Press.
2. Karl K. Turekian. 1996. Global Environmental Change-Past, Present, and Future. Prentice-Hall.
3. Richard Anthony Matthew. 2009. Jon Barnett, Bryan McDonald. Global Environmental Change and Human Security . MIT Press., USA.
4. Hester, R.E. and Harrison, R.M. 2002. Global Environmental Change. Royal Society of Chemistry.

ESM – 106: Lab work based on courses ESM – 101 and ESM – 102

ESM – 107: Lab work based on courses ESM – 103 and ESM – 104

SEMESTER – II

ESM – 201: Biodiversity and Conservation

Introduction to biodiversity: species, genetic and ecosystem diversity.

Biodiversity magnitude and distribution: diversity gradients and related hypotheses, biodiversity and ecosystem function, methods for biodiversity monitoring.

Biodiversity and ecosystem services: provisioning, regulating, cultural and supporting.

Threats to biodiversity: Natural and anthropogenic, species extinctions, IUCN threat categories, Red data book, Invasions: causes and impact.

Biodiversity conservation, principles and strategies; *in-situ* and *ex-situ* conservation, Protected Area Network.

Biodiversity Hot spots: concepts, distribution and importance.

Use of biodiversity: Source of food, medicine, raw material, aesthetic and cultural.

Biodiversity prospecting.

Suggested Readings:

1. Anne E. Magurran. 2003. Ecological diversity and its measurements. Blackwell Publications.
2. J.S.Singh, S.P. Singh and S.R. Gupta. 2008. Ecology, Environment and Resource Conservation. Anamaya Publications (New Delhi).
3. V.H. Heywood and Watson R.T. (Ed). 1995. Global Biodiversity Assessment: UNEP. Cambridge University Press.

ESM – 202: Energy Resources and Conservation

Introduction: Energy, work and power; Energy and people; Energy sources – Resource and reserves - an overview; an overview of the current global and National Energy Scenario.

Fossil Fuels: Oil, coal, natural gas, shale, tar sands – Sources, exploration, exploitation; environmental consequences.

Nuclear Energy: Nuclear fission and Fusion; Nuclear fuel cycle, Nuclear reactors (PWR, BWR, Gas Cooled Breeder) and nuclear power.

Renewable and Alternative Energy Sources: Solar energy, solar power, photovoltaic cells; Wind power; Geothermal energy; Ocean energy; Fuel cells.

Bio Energy: Biomass conversion processes; Biodiesel; Environmental consequences of biomass resource harnessing.

Energy Conservation: National energy policy, energy efficiency improvement, audit and energy saving.

Suggested Readings:

1. M. Dayal. (6th Ed). 1997. Renewable Energy: Environment and Development. Konark Pub. Pvt. Ltd.
2. S. Vandana. 2002. Alternative Energy. APH Publishing Corporation.
3. S. K. Agarwal. 2003. Nuclear Energy: Principles Practice and Prospects. APH Publishing Corporation.
4. P. Chaturvedi. 1995. Bio-Energy Resources. Concept Publications.
5. V S. Mahajan. 1991. National Energy: policy, crisis and growth. Ashish Publishing House.

ESM – 203: Environmental Pollution and Toxicology

Air pollution: Types and sources, Effects of SO₂, NO₂, O₃, HF, photochemical smog and particulates on plants and human health, aeroallergens and allergies.

Ozone layer depletion: Causes and consequences.

Noise pollution: Types, sources and effects on human health.

Water Pollution: Types and sources; Effects on water quality, plants and human health; Thermal pollution.

Soil pollution: Types and sources, Effects of pesticides and heavy metals on ecosystems, mechanisms of metal toxicity, metallophytes.

Radioactive pollution: Sources and hazards.

Solid waste: Sources and effects.

Toxicology: Principles of toxicology, dose-response relationships, Chronic and acute toxicity; Effective concentration, LD₅₀, Median tolerance limit and Margin of safety;

Toxicity testing (Holistic and Numeric approach).

Uptake, bioaccumulation, bio-transformation and excretion of xenobiotics.

Role of temperature and humidity in human health.

Suggested Readings:

1. A. K. De. (3rd Ed). 2008 Environmental Chemistry. New Age Publications India Ltd.
2. I. C. Shaw and J. Chadwick. 1997. Principles of Environmental Toxicology. Taylor & Francis Ltd.
3. S.C. Santra. 2011. Environmental Science. New Central Book Agency.
4. Ira. S. Richards. 2008. Principles and Practices of Toxicology in Public Health. Jones and Barlett Publications.

ESM – 204: Environmental Monitoring and Management

Ambient air monitoring; Methods of collection and analyses of gaseous and particulate pollutants.

Methods of collection of water samples and analyses of physico-chemical characteristics.

Methods of collection of soil samples and analyses of physico-chemical characteristics.

Bio-monitoring and bio-indication.

Principles of chromatography, spectrophotometry, electro-analytical and radio-analytical techniques.

Environmental Management: Principles and strategies ; Indicators of environmental quality, economic valuation; pipeline model; closed loop model and material balance model; environmental cost-benefit analysis; sources of uncertainty in cost and benefit estimates; Fiscal incentives in pollution control and management.

Environmental management system (EMS): ISO-14000; Environmental audit; Environmental clearance for establishing industries; Environmental Impact Assessment (EIA); EIA guidelines 1994, Environmental taxes.

International trade and environment; Trade Related Intellectual Properties (TRIPs), Intellectual Property Rights (IPRs), Corporate environmental ethics.

Suggested Readings:

1. C. N. Sawyer, P. L. McCarty and G. F. Parkin. 2002. Chemistry for Environmental Engineering and Science. John Henry Press.
2. H. H. Rump. 2000. Laboratory Manual for the Examination of Water, Waste water and soil. Wiley-VCH.
3. R. K. Sapru. 1987. Environmental Management in India (Vol. I & II). Ashish Publishing House.

4. Bryan F.J. Manly. 2009. Statistics for Environmental Science and Management. CRC Press.

ESM – 205: Lab work based on courses ESM - 201 and ESM – 202

ESM – 206: Lab work based on courses ESM – 203 and ESM - 204

ESM – 207M: Natural Resources and Management

Atmosphere: Composition, atmospheric chemistry; weather pattern

Aquatic system: Diversity, characteristics, watershed management, rain water harvesting.

Biodiversity: Importance, threats, approaches for conservation and management.

Soil: Resources, fertility and agricultural sustainability; Soil erosion and conservation;

Restoration of contaminated soils. Waste management

Energy: Basics of energy and its various forms; Energy management and audit.

Suggested Readings:

1. B.R. Gurjar, Chandra S.P. Ojha, L.T. Molina. 2010. Air Pollution. CRC Press.
2. W.N. Beyer and J.P. Meador. 2011. Environmental Contaminants in Biota. CRC Press.
3. E.N. Laboy-Nieves, M.F.A. Goosen and E. Emmanuel. 2010. Environmental and Human Health. CRC Press.
4. Vaughn Nelson. 2011. Introduction to Renewable Energy. CRC Press.

SEMESTER - III

ESM – 301: Biostatistics and Modeling

General concepts and terminology; sampling methods; distribution of attributes; tests of hypothesis and significance; contingency tables and chi-square test; comparison of means: t-test, multiple range tests; Simple experimental design and analysis of variance; correlation and regression analysis; Introduction to multivariate methods.

Approaches to development of models; conceptual, statistical and mathematical models; steps in the modeling process; single and multiple regression models; modeling coupled human-natural systems; model testing and validation; models as predictive tools.

Suggested Readings:

1. S. C. Gupta and V. K. 1986. Kapoor. Fundamentals of Mathematical Statistics. S. Chand & Co.
2. Aslam Mahmood. 1993. Statistical Methods in Geographical Studies. Rajesh Publications, New Delhi.
3. J. Medhi. Statistical Methods: 1992. An Introductory Text. New Age International Ltd. Publishers.
4. Gupta, S. P. 2000. Statistical Methods. Sultan Chand & Sons, New Delhi.

ESM – 302: Water Resource Management

Global distribution of water resources, water need and consumption; Threats to surface water resources; Principles and approaches to surface water management.

Watershed management: Rain water harvesting and storage, recharging of ground water; role of dams.

Properties of sewage and industrial effluents; effluent standards; treatment of industrial effluents, sewage treatment (primary, secondary and tertiary treatment), advanced treatments (nitrate and phosphate removal); Sludge treatment and disposal; Waste water use.

Drinking water quality and water treatment (desalination, ion-exchange, reverse osmosis and disinfection of water).

Suggested Readings:

1. A.J. Schleiss and R.M. Boes. 2011. Dams and Reservoirs under Changing Challenges. CRC Press.
2. J.N. Parkinson, J.A. Goldenfum and C.E.M. Tucci. 2010. Integrated Urban Water Management. CRC Press.
3. A.N. Findikakis and K Saro. 2011. Groundwater Management Practices. CRC Press.

ESM – 303: Lab work based on courses ESM – 301 and ESM – 302

Any one of the following two (ESM - 304 and ESM 305):

ESM – 304: Ecological Restoration

Definitions and concept, reclamation, remediation, restoration and rehabilitation.

Disturbance: causes and impact on the structure and functioning of terrestrial and aquatic ecosystems.

Aims and strategies: Passive and active; habitat, species and ecosystem restoration; single vs. multiple end-points.

Ecosystem reconstruction: Acceleration of ecological succession, physical, chemical, biological and biotechnological tools.

Restoration of biological diversity: Augmentation, reintroduction and introduction of species.

Degradation and restoration of natural ecosystems: Forests, grassland/savanna, wetlands and other aquatic ecosystems.

Restoration of degraded soils: Restoration of contaminated soils and soil fertility, mine spoil restoration.

Suggested Readings:

1. Paul E Hardisty. 2010. Environmental and Economic Sustainability. CRC Press.
2. S.C. Santra. 2011. Environmental Science. New Central Book Agency.

ESM – 305: Society and Environment

Social perspectives of environment: Global and Indian issues.

Sustainable development: Concept, components and strategies.

Social impacts of growing human population and affluence, food security, hunger, poverty, malnutrition, famine.

Social impacts of water crisis, global climate change, O₃ depletion, nuclear accidents, acid rain, consumerism and waste products.

Problems related to major dams and other developmental projects, resettlement and rehabilitation.

Environment and human health: epidemiological issues, women and child welfare, family welfare programme.

Environmental education, Environmental ethics, public awareness, peoples participation in resource conservation and environmental protection.

Suggested Readings:

1. S.C. Naik and T.N. Tiwari. 2006. Society and Environment. Oxford & IBH Publishers.
2. S.C. Santra. 2011. Environmental Science. New Central Book Agency.
3. See net, a lot of information is available including PDF files.

Any one of the following two (ESM 306 and ESM 307):

ESM: 306: Air Pollution Control and Abatement

Air quality criteria and standards, air pollution indices; National Environment policy; National air monitoring programme.

Control of inorganic emissions, clean coal technology, coal conversion, industrial clean-up technology.

Air pollution control equipments: settlers, cyclone collectors, air filters, scrubbers and electrostatic precipitators.

Control of CO, SO₂, NO_x and VOCs emissions, control of vehicular emission.

Indoor air quality control.

Biological abatement of air pollution, scope of green belt development, phytoremediation.

Noise pollution: Standards, abatement and control.

Economic aspects of air pollution control.

Suggested Readings:

1. V.P. Kudesia. 1997. Air Pollution. Pragati Prakashan.
2. M.H. Rao and H.V.H. Rao. 1998. Air Pollution. Tata McGraw Hill Publication.
3. B.R. Gurjar, L. T. Molina and C. S. P. Ojha. 2010. Air Pollution. CRC Press.

ESM – 307: Remote Sensing and GIS

Electromagnetic Radiation as Remote Sensing Medium; General Mechanism of Remote Sensing Data Recording; General Characteristics of Remote Sensing Platforms; General Characteristics of Remote Sensing Sensors; Indian Remote Sensing Satellites and Sensors.

Spectral Characteristics of Common Natural Objects; Atmospheric Effects on Remote Sensing Data; Spectral Signatures and Spectral Response Patterns; Resolution of Remote Sensing Data; Characteristics of Raw Remote Sensing Data

Nature of Qualitative Information and Sequence in Interpretation; Elements of Image Patterns-Landforms, Drainage, Erosion Details; Applications of Remote Sensing; Remote Sensing Applications in Environmental Studies; Digital Image enhancement and classification methods; Principles of Microwave Remote Sensing; Characteristics of Microwave remote sensing Data; Radar and Lidar: Applications of Microwave Remote Sensing Data.

Geographical Data and GIS; Coordinate Systems and Datums; Digital representation of geographical data-Raster and Vector models; GIS Data Standards-Concepts and Components; Conceptual and Logical Data Modeling; Applications of GIS

Suggested Readings:

1. 1. Burough, P.A. and McDonnel, R. 1998. Principles of Geographical Information Systems. Oxford University Press, NY.
2. Campbell, J.B. (2nd Ed), 1996. Introduction to Remote Sensing. Taylor and Francis.
3. Christopher, J. 1997. Geographical Information Systems and Computer Cartography. Longman.
4. Reeves, Robert G. 1999. Manual of Remote Sensing, (Vols. I & II). American Society of Photogrammetry and Remote Sensing, USA.
5. Rencz, A.N. (3rd Ed.) Remote Sensing for the Earth Sciences: Manual of Remote Sensing. John Wiley & Sons, Inc., New York.
6. Sabins, F. F. Jr. (2nd Ed). 1986. Remote Sensing: Principles and Interpretation. W.H. Freeman & Co.

ESM –308: Lab work based on ESM – 306/ESM – 307**ESM – 309M: Environmental Pollution**

Air Pollution: Types and sources, effects on ecosystem and human health.

Water Pollution: Types and sources, effects on aquatic ecosystem and human health, eutrophication and its control.

Soil Pollution: Types and sources; Effects of pesticides and heavy metals on ecosystem and human health; Biomagnification.

Noise Pollution: Sources, permissible limit, effects on human health.

Suggested Readings:

1. B.R. Gurjar, C.S.P. Ojha and L.T. Molina. 2010. Air Pollution-Health and Environmental Impacts. CRC Press.
2. J.S. Jean, J. Bundschuh and P. Bhattacharya. 2011. Arsenic in Geosphere and Human Diseases. CRC Press.
3. I.L. Pepper, C.P. Gerba and M.L. Bresseau. 2006. Environment and Pollution Science. Academic Press.

SEMESTER – IV**ESM – 401: Disaster Management**

Understanding hazards and disasters, hazards to environment, risk Assessment, vulnerability analysis.

Dimensions of disaster, disaster impact assessment; types of disaster impact; disaster trends and patterns; flood, drought, cyclone, tsunami, earthquake and volcanoes & its management.

Understanding natural and man-made disaster; disaster preparedness; disaster responses; reducing the impacts of disaster.

Biophysical hazards; disaster due to diseases; disaster in medicines; disaster aid; Community preparedness; forecasting and warning; rehabilitation; reconstruction and recovery; slope Instability and landslide hazard.

Suggested Readings:

1. G. F. White (Ed). 1974. Natural Hazards – Local, National, Global. Oxford University Press.
2. V.T. Chow. 1964. Handbook of Applied Hydrology. McGraw-Hill.
3. A. N. Strahler and A. H. Strahler. 1973. Environmental Geoscience - Interaction Between Natural Systems and Man . Santa Barbara, California: Hamilton Publishing.
4. P. Reining. 1978. Handbook of Desertification Indicators. Washington D.C.: American Association for the Advancement of Science.
5. K. S. Valdiya. 1987. Environmental Geology. Tata McGraw-Hill.

ESM – 402: Environmental Legislation

Fundamental right to clean environment and duties; State's obligation.

Power of Parliament to legislate environmental legislations.

Definition- Environment, air pollution, water pollution, hazardous substances, handling, animal article, forest, non-forest purposes, biodiversity.

Environmental legislation enforcement authorities: (i) Under the Water and Air Act-composition, powers and functions, and (ii) Under the Environment (Protection) Act, 1986- powers

Environmental dispute redress bodies: (i) National Green Tribunal – composition and jurisdiction, (ii) Trial court- jurisdiction under the environmental legislations, and (iii) Executive Magistrate' s powers

The Forest (Conservation) Act 1980: Objectives and Mechanism.

The Wild Life (Protection) Act 1972: Objectives, prohibition on hunting and trade.

The Biodiversity Act 2002: object and National Biodiversity Authority.

Convention on Climate Change: objectives, principles and commitment-India's response.

Suggested Readings:

1. Environmental Laws. 2005. Universal Law Publishing.
2. S. Diwan and A. Rosencranz. 2005. Environmental Law and Policy in India. Oxford Univ. Press.

ESM 403: Industrial Training Report

Students shall be required to go for Industrial training (4 credits) of four weeks during summer vacation after completion of Semester II examination. The training will be evaluated during Semester IV on the basis of a report and presentation.

ESM 404: Dissertation based on project work

The project work (10 credits) will be carried out by the students in semester IV and work will be evaluated on the basis of dissertation and presentation.

ESM 405: Field Study and Report thereof

Students are required to visit any local industry, river or other site and prepare a study report thereof. The field study will be evaluated on the basis of report and presentation.