Syllabus M.Sc. (Environmental Science)

Session: 2019-20

First Semester

(A). Choice Based Credit

ESM-101: Instrumentation and Biostatistics	**(OP)**	**L- T - P**
Or		**04- 02– 00**
ESM-102: Environmental Biotechnology	**(OP)**	**L- T- P** **04 -02 - 00**
Or		
ESM- 103: Microorganisms and Environment	**(OP)**	**L- T- P** **04-02- 00**

Or

For Choice Based Credit, **06 credits** from other departments the students are advised to contact following departments-

1. Deptt. of Economics
2. DepttofLaw
3. Deptt. of Management
4. Deptt. of Biotechnology
5. Deptt. of Microbiology
6. Deptt. of Applied Plant Science
7. Deptt. of Sociology
8. Deptt. of Human Rights
9. Deptt. of Pharmaceutical Science
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11. Deptt. of Mass Communication & journalism
12. Deptt. of Applied Animal Science
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14. Deptt of Applied Chemistry
15. Deptt. of History
16. Deptt. of Home Science
17. M.Sc. Programme of Industrial Microbiology
18. M.Sc, Programme of Food Microbiology

(B). Compulsory Paper

ESM-104: Ecosystem Dynamics &, Biodiversity conservation	**(CP)**	**L- T- P** **04 - 02 - 00**
ESM -105: Environmental Chemistry	**(CP)**	**L- T- P** **04 - 02 - 00**
ESM -106: PRACTICAL/ Educational Excursion	**(CP)**	**L- T- P** **00 - 00 - 06**

Second Semester

(A). Choice Based Credit (Choice for any two of the following paper)

ESM-201: Energy Resources & Management	**(OP)**	**L- T- P** **02- 01- 00**
ESM -202:Nanotoxicology: Concepts and Advances	**(OP)**	**L- T- P** **02- 01- 00**
ESM-203: Environmental Stress Biology	**(OP)**	**L - T- P** **02 -01- 00**
ESM-204: Climate Change, Concept, Issues and Challenges	**(OP)**	**L – T - P** **02 - 01-00**
ESM-205:Water Treatment Technology	**(OP)**	**L – T - P** **02 -01-00**

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(B). Compulsory Paper

ESM -206: Environmental Pollution, Geosciences & Remote Sensing Application	**(CP)**	**L- T- P** **04- 02- 00**
ESM-207: Environmental Microbiology & Biotechnology	**(CP)**	**L- T- P** **04- 02- 00**
ESM-208:PRACTICAL/Educational Excursion	**(CP)**	**L - T- P** **00 -00- 06**

Third Semester

(A). Choice Based Credit

(Choice for any two of the following paper)

ESM-301: Natural Resources Economics	**(OP)**	**L- T- P** **02- 01- 00**
ESM-302: Water Quality Modeling	**(OP)**	**L- T- P** **02- 01- 00**
ESM-303: Climate Change and sustainable Development	**(OP)**	**L- T- P** **02- 01- 00**
ESM- 304: Solid and hazardous waste management	**(OP)**	**L – T - P** **02 -01 - 00**
ESM- 305: Environmental Policies, Organizations and Treaties	**(OP)**	**L – T - P** **02 - 01-00**
ESM- 306: Microorganisms in Agriculture and Environment	**(OP)**	**L – T- P** **02 -01- 00**

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(B).**Compulsory Paper**

ESM-307: Environmental Toxicology & Occupational Health Hazards	**(CP)**	**L- T- P** **04- 02- 00**
ESM-308: Environmental Management & EIA	**(CP)**	**L- T- P** **04- 02- 00**
ESM-309: PRACTICAL/Educational Excursion	**(CP)**	**L -T - P** **00 -00- 06**

Fourth Semester

ESM-401: Dissertation **(24 Credits)**

(Internal Evaluation)

(a) Synopsis	04 Credits
(b) Midterm Presentation	06 Credits

(External Evaluaton)

(c) Dissertation Report	08 Credits
(d) Presentation/Viva-Voce	06 Credits

First Semester

(A). Choice Based Credits

ESM- 101: Instrumentation and Biostatistics **(OP)** **L - T- P**

04- 02- 00

UNIT I : Principles and application of microscope, Phase contrast, scanning and transmission electron microscope, Principle and application of centrifuges, Types of centrifuges, Principle and application of electrophoresis, SDS-PAGE and agarose gel electrophoresis.

UNIT II : Principles and application of spectroscopy, UV- VIS Spectrophotometer, UV-Vis spectrofluorimeter, Principle and application of Flame photometer, Atomic Absorption spectrophotometer, Fourier Transmission Infra-red (FTIR) spectrophotometer.

UNIT III: Principle and application of chromatography, Thin layer chromatography, Gas chromatography and High performance liquid chromatography.

UNIT IV : Presentation of sampled data, measures of central tendency & dispersion, normal distribution, probability, t-test, chi-square test, Linear simple and multiple regression models, Environmental system analysis.

Or

ESM- 102: Environmental Biotechnology **(OP)** **L – T - P**

04-02-00

UNIT I: Biotechnology &Environmental sustainability, & DNA technology, immobilization of biomolecules and cells, degradative plasmids, genetic transformation in microbes and plants.

UNIT II: Natural resource recovery using microbes and plants, bio mining and phytomining, biopolymers,

Unit-III: Biodegradation of Xenobiotics such as plastic, petroleum products and halogenated pesticides,

Unit IV: Biosurfactant, biosensors & environmental monitoring.

Or

ESM- 103: Microorganisms and Environment **(OP)** **L – T- P**

04-02-00

UNIT I: Microorganisms, Bacteria, Fungi, Viruses- Structure and classification, Roles in environment.

UNIT II: Air Microbiology, Water Microbiology (rivers, lakes, oceans), Soil Microbiology, Rhizosphere Microbiology.

UNIT III: Isolation and enumeration of microorganisms. Preservation methods, Identification of microorganisms, Control of microorganisms.

UNIT IV: Microbial Ecology, Nutritional types including Photosynthetic Microbes, Chemoautotrophs, Extremophiles- Thermophiles, Psychrophiles, Halophiles.

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(B). Compulsory Paper

ESM- 104: Ecosystem Dynamics and Biodiversity Conservation (CP) L – T- P 04–02-00

UNIT I : Principles and scope of environmental science, concept of ecosystem, food chain and food web, Energy flow, soil profile, humus formation, Biogeochemical cycles (C,N,P),Geographical classification and biomes.

UNIT II : Theories of population growth, biotic potential, inter and intra species interaction in ecosystem, Models of population growth Lotka-voltera model and Leslie's matrix model.

UNIT III : Community ecology, Succession, xerosere, hydrosere, concept of climax, theories of climax, habitat and ecological niche, allelopathy.

UNIT IV : Concept and components of 'biodiversity, genetic, species and ecosystem diversity, biodiversity conservation, wildlife reserves National park/Sanctuaries in India, Biodiversity hotspots, national and global red data book, Wetlands and biodiversity.

ESM- 105: Environmental Chemistry (CP) L – T – P 04 –02 -00

UNIT I : Basic Concept of chemical potential and chemical equilibrium, Chemistry of Gaseous and particulate pollutants, oxygen and ozone chemistry, fog and smog, effects of photochemical smog radionuclide.

UNIT II: Classification and chemistry of pesticides, types and composition of paints. Environmental of impact of Hydrocarbons plastics.

UNIT III: Physico-chemical properties of soil and water, BOD and COD; eutrophication, chemistry of metal corrosion and methods of preventing the corrosion of metals.

UNIT IV: Food additives: sweeteners, preservatives, dye etc. Chemistry of ionic and non-ionic detergents & bleaching agents, Chemistry of dyes.

ESM- 106: **PRACTICAL /Educational Excursion (CP) L - T - P 00– 00-06**

Second Semester

(A). Choice Based Credits (06)
(Choice for any two of the following paper)

ESM- 201: Energy Resources & Management **(OP)** **L – T - P**
02– 01- 00

UNIT I : Fundamentals of energy, types of energy resources, relationship among energy environment & development, Indian energy scenarios for domestic, agriculture, transport and industrial reactor & their impacts on environment. Conventional energy sources: coal, petroleum & natural gas; resource and reserves in India nuclear energy fission energy, fission energy, environmental impact of conventional energy sources: case histories.

UNIT II: Renewable & nonrenewable source of energy, solar energy, wind , tidal energy, geo-thermal, mini and micro hydropower development OT EC, hydrogen energy. Application of renewable energy and environmental impacts, conservation of sources, bio energy profiles and energy recovery from wastes.

ESM- 202: Nanotoxicology: Concepts and Advances **(OP)** **L- T- P**
02-01-00

UNIT I: Nanomaterials: Definition, Types, Concepts and definitions of nanomaterials from quantum dots to graphene to fullerenes, functionalization, stability, and medical and biological applications. Introduction to engineered nanostructures, biological and environmental interactions with nanostructures. Systematic approach to nanotoxicology and the developing risk factors associated with nanosized particles during manufacture and use of nanotechnology, methodologies to assess cytotoxicity and genotoxicity to ecotoxicity.

UNIT II: *in vitro* and *in vivo* studies for specific nanomaterials including solid lipid nanoparticles and nanostructured lipid carriers and metallic nanoparticles and metallic oxides. Coverage includes interactions with blood (erythrocytes), combinatorial and microarray techniques, cellular mechanisms, and ecotoxicology assessments. Toxicological aspects of poloxamers and polymeric nanoparticles as drug carriers as well as size effects on cytotoxicity and genotoxicity. Range of applications, from biogenic silver nanoparticles to poloxamers as drug-delivery systems, reflecting the expanding applications of nanotechnology

ESM- 203: Environmental Stress Biology **(OP)** **L – T- P**
02-01-00

UNIT I: Concept of environmental stresses, signaling molecules and mechanism of signal transduction membrane dynamics and cellular responses under salinity, & drought stress,
high temperature & freezing stresses, role of some common & specific stress proteins, cellular response to nutritional stress (N, P, Ca & Fe deficiencies) in plants.

UNIT II : Physiological response of plants to heavy metal (Ni, Co, Mn, Cu, Cd, Pb, Mg) toxicity, role of metallothiones & Phytochelatins, UV radiation stress and oxygen freeradicals. Antioxidant defense mechanism in plants.

ESM- 204: Climate Change; Concept, Issues and Challenges (OP) L – T - P 02-01-00

UNIT I : The Earth's climate, concepts and evidences of climate change, climate variation and climate change, Major characteristics of Climate Change and its causes, Green House Gases (GHGs); sources, warming potentials and persistence in nature.

UNIT II: Potential impacts of climate change on economy, biodiversity and agriculture. Global Summits, COP-21 and onwards climate change debates and Intended Nationally Determined Contributors (INDCs), Clean Development Mechanisms CDM

ESM- 205: Water Treatment Technology (OP) L – T - P 02-01-00

Unit I: Aeration; sedimentation/clarification; coagulation, coagulation theory and Jar test.

Unit II: flocculation; softening; ion exchange; filtration; disinfection, and adsorption.

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(B). Compulsory Paper

ESM- 206: Environmental Pollution, Geosciences &Remote Sensing application **(CP)** **L – T - P 04-02-00**

UNIT I : Air pollution monitoring and control of air pollutants, air quality standards, water pollution and marine pollution, water quality standards, physico-chemical and biological treatment of waste water

UNIT II: Processes and principles of-land forms development, principles of meteorology and climatology, atmospheric stability, principles of hydrology, techniques of measurements & analysis of surface & subsurface water.

UNIT III : Catastrophic geological hazards, Principles of disaster management, study of Earthquake, floods, drought, wave & tsunami effects & avalanches, volcanic/ hazards, el-nino, melting of ice sheets.

UNIT IV : Principal of remote sensing and application of GIS in environmental management, satellite, usage and application, land use planning & methods of site selection & evaluation.

ESM- 207: Environmental Microbiology **(CP)** **L - T- P 04- 02- 00**

UNIT I: Microbial diversity and microbial interactions in environment, microbial resistance to metals and pesticides, biological nitrogen-fixation by microorganisms and biofertilizers, microbial toxins, biopesticides.

UNIT II: Role of Microbes in soil fertility and plant growth promoting rhizobacteria (PGPR), microbial leaching, biocomposting, VAM.

UNIT III: Concept of Bioremediation of pollutants, types of bioremediation, Role of genetically modified microorganisms in environmental clean-up, vermiculture technology.

UNIT IV: Pathogenic microbes and human health, Water borne diseases; such as typhoid, cholera, dysentery, malaria and their prevention. Air borne disease caused by aeroflora, aeroallergens and allergies.

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ESM-208: PRACTICAL/Educational Excursion **(CP)** **L – T - P 00 - 00 - 06**

Third Semester

(A) Choice Based Credit (06)
(Choice for any two of the following paper)

ESM- 301: Natural Resources Economics **(OP)** **L - T - P**
02 -01-00

UNIT I: Economics Development and sustainable Development, measurement of environmental values, valuation methods, theory of environmental policy, environmental extenalities pigovian Taxes & subsidies, Intergenerational well being& equity, SD indicators, NRA.

UNIT II: Economics of natural resource management & sustainable development, theories of optional use of exhaustible & renewable resources, integrate & environmental &economics. Accounting in the measurement of environmentally corrected GDP, concept of natural capital & sustainability.

ESM- 302: Water quality Modeling . (OP) **L – T - P**
02-01-00

UNIT I : Historical perspective water quality models & water resource management systems, fundamentals of water quality modeling completely mixed system concept of continuously stirred tank reactors (CSTR) mass balance approach, different type of loading, feed forwarding & feedback system of reactors; incompletely mixed system, steady & unsteady state system.

UNIT II: surface water quality propelling: river & streams; estuaries & lakes; dissolved oxygen models: DO sag model; BOD model, Streeter Phelps equation for point and distributed sources; eutrophication models for lakes & flowing water.

ESM- 303: Climate Change and Sustainable Development **(OP)** **L – T- P**
02-01-00

Unit I: Most vulnerable sectors to climate change crisis, Adaptations to negative impacts of climate change, Green Technologies, Ecological Agriculture, Remedial and Mitigation measures

Unit II: Principles of Sustainable development, Climate Resilient developmental mechanisms, Green buildings, Smart Cities, Satellite Towns and Cities, Green belts and Agro-forestry, Constructed Wetlands, Designer Ecosystems

ESM- 304: Solid and hazardous waste management **(OP)** **L – T - P**
02-01-00

Unit I: Integrated solid waste management, and disposal of solid wastes; waste to energy; Legislations for the solid waste management.

Unit II: Hazardous wastes characterization, Storage and Transportation; Treatment and disposal of hazardous wastes.

ESM- 305: Environmental Policies, Organizations and Treaties **(OP)** **L – T- P 02-01-00**

UNIT I: Introduction to environmental policy and its approach to the ethical, political, technological, scientific, economic, and management aspects of environmental issues. Case studies in the real-world including leaks in underground storage tanks, toxic waste cleanup, and the effects of global climate change.

UNIT II: Making a framework in generating meaningful action and policy solutions to current environmental issues. Issues concerning congestion taxes, e-waste, and recent developments in global climate change, Role of International Organizations and global environmental issues. Recent updates throughout and incorporating the policy changes, Conference of Parties, Agreements, Accords and Treaties specially Kyoto, Montreal, Copenhagen, Paris etc

ESM- 306: Microorganisms in Agriculture and Environment **(OP)** **L – T - P 02-01-00**

UNIT I: Production of biofertilizers and biopesticides, History and development, Applications of bioinoculants in fields, Bt and pest control.

UNIT II: Microorganisms as source of food, Single cell protein, Mushroom, Microbes as source of Biofuels and energy, Microbes in treatment of waste water.

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(B). Compulsory Paper

ESM- 307: Environmental Toxicology & Occupational Health Hazards (CP) L – T - P

04 -02-00

UNIT I: Principles and mechanisms of toxicity, dose response curve, process of biotransformation & bio activation. Toxicity of hydrocarbons, Arsenic, fluoride and heavy metals & their impacts on human health.

Unit II: Target and non target toxicity, Hepatotoxicity, Nephrotoxicity, Neurotoxicity, Respirotoxicity, Reproductive toxicity

Unit III: Immunotoxicity, Carcinogenesis, Mutagenesis, Developmental toxicology: Teratogens and their effects

Unit IV: Occupational toxicology: Occupational toxicants, exposure limits, Risks associated with hazardous substances, Risk assessment and management guidelines, Occupational/Industrial hygiene, Hazard control.

ESM- 308: Environmental Management and EIA (CP) L- T- P

04– 02 -00

UNIT I: Concept of environmental management and sustainable development, cost-benefit analysis, restoration & rehabilitation technologies ecotourism, conservation of cultural heritage & green belt designing.

UNIT II : Concept of environmental impact assessment EIA and guidelines, impact assessment methodologies, environmental impact statement(EIS) and environmental assessment plan (EMP) Principles & practice of environmental auditing, objectives, procedures & benefits, ISO 14001 series.

UNIT III : Recycling of wastes, management of hazardous wastes, concept of life cycleanalysis (LCA) and risk assessment, eco-labelling, carbon trading.

UNIT IV: Concept of environmental laws, Environmental Acts and regulations for prevention of pollution. International environmental agreements, conventions & protocols.

ESM-309: PRACTICAL/Educational Excursion (CP) L – T- P

00-00-06

Fourth Semester

ESM- 401: Dissertation **(Credits: 24)**

(Internal Evaluation)

(c)	Synopsis	04 Credits
(d)	Midterm Presentation	06 Credits

(External Evaluation)

(c)	Dissertation Report	08 Credits
(d.)	Presentation/Viva-Voce	06 Credits