SCHOOL OF ENVIRONMENTAL SCIENCE
Dr. S.P.M. UNIVERSITY, RANCHI

Syllabus for
M. Sc.
ENVIRONMENTAL SCIENCE BASED ON CBCS PATTERN
(Effective From Session 2018-20)

M.Sc Environmental Science

SEMESTER I

Core course-I: FUNDAMENTALS OF ENVIRONMENTAL SCIENCE, ENERGY FLOW, CONCEPT OF FACTORS , BIOGEOCHEMICAL CYCLES

Full Marks: (70+30) 100 Exam Duration: 3 Hours Total Lectures:35

There shall be seven questions in total. Question no. 1 is compulsory and span over the entire subject of this paper in the form of multiple choices / true or false / fills in the blanks with options etc and will carry 10 marks. From the rest 6 questions (3 from each unit carrying 20 marks) examinees will be required to answer three, selecting not more than two from any one unit. Number of lectures is in parenthesis.

UNIT- I: FUNDAMENTALS OF ENVIRONMENTAL SCIENCE (10)

- Various disciplines of environmental science.
- Concept of: biosphere, biome, ecosystem, subdivisions of the biosphere: lithosphere, atmosphere, hydrosphere.
- Concepts pertaining to the ecosystem: Ecosystem organization: structural and functional. Concept of trophic levels, food chains, food web. Comparison of ecosystem through number, biomass and energy pyramids. Concept of ecosystem dynamics; stability of ecosystems and control mechanisms: homeostasis, homeorhesis, microcosms and mesocosms.
- Impact of man on ecosystems.

ENERGY FLOW (15)

- Concept of energy, energy reaching the earth, light as an energy carrier, energy transduction with respect to the laws of thermodynamics, concept of entropy and enthalpy, the ecosystem as a thermodynamic unit. Energy base for plants, photosynthesis, energy fixation and production. Energy flow through the food chain, the 10 percent law,
- Lindeman's trophic dynamic aspect.
- Energy flow models: basic or universal model, energy flow models of ecosystems (aquatic and terrestrial), comparison of energy flow in different ecosystems.
- Energy flow through the detritus pathway, role of decomposers.

UNIT- II: CONCEPT OF FACTORS (15)

- Concept of environmental factors, adaptation to the environment, specialization and generalization.
- Detailed study of the following factors: light, heat, carbon dioxide, and oxygen, with reference to its impact on the biota, and the recent changes that have occurred due to anthropogenic activity.
- Concept of limiting factors and factor interaction, application of the knowledge for the benefit of man

CONCEPT OF BIOGEOCHEMICAL CYCLES (20)

- Elements and their distribution, concept of macro and micronutrients, cycling process and transfer routes, energy required.
- Types of biogeochemical cycles: gaseous, sedimentary, local and global cycles, residence time, role of decomposers, dependence on the water cycle.
- Detailed study of the following cycles: water, oxygen, carbon, nitrogen, sulphur, phosphorus, Balance sheet and global budget of the normal process. Impact of man on the cycling process.
- Concept of nutrient budgeting of ecosystems.

Internal assessment 30 Marks

M.Sc Environmental Science
SEMESTER I

Core course-II : CONCEPTS PERTAINING TO PRODUCTIVITY, SYSTEM CONCEPT AND DYNAMICS, COMMUNITIES AND THEIR DEVELOPMENT, BIOMES AND BIOGEOGRAPHY

Full Marks: (70+30) 100 Exam Duration: 3 Hours Total Lectures:35

There shall be seven questions in total. Question no. 1 is compulsory and span over the entire subject of this paper in the form of multiple choices / true or false / fills in the blanks with options etc and will carry 10 marks. From the rest 6 questions (3 from each group carrying 20 marks) examinees will be required to answer three, selecting not more than two from any group. Number of lectures is in parenthesis.

UNIT I CONCEPTS PERTAINING TO PRODUCTIVITY (15)

- Productivity in ecosystems; concept of gross production, net production, net ecosystem production; primary production, factors affecting primary production.
- Global primary productivity and its estimation.
- Secondary production, factors affecting secondary production; efficiency of production at various levels.
- Succession and changes in productivity.
- Measurement of primary and secondary productivity.
- Man's use of productivity and the global scenario with respect to food production and population increase.

SYSTEM CONCEPT AND DYNAMICS (10)

- System concept, system analysis, system measurement, data analysis.
- System modeling: analytical models, stochastic models.
- Data processing, Computer programming (basics), data structure and organization, building models, use of microcosms and mesocosmsin model building.
- Development of a model

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UNIT- II COMMUNITIES AND THEIR DEVELOPMENT (20)

- The community concept.
- Development of the community through succession.
- Community organization and stratification.
- Classification of the community on the basis of life forms.
- The continuum concept and ordination. Ecotone and ecotype.
- Concept of species diversity, various diversity indices, changes in diversity with community development, impact of man on global diversity.
- The niche concept: fundamental and realized niche, niche competition, niche width, niche overlap, changes in niche dimensions with stress, characteristics of the niche, niche adjustments. Community periodism as a niche dimension: circadian, circannual and lunar rhythms, hormonal control.
- Impact of the community on the environment.

BIOMES AND BIOGEOGRAPHY (15)

- Concept of biogeography, components of species diversity, species richness, and relative abundance.
- Continental drift, dispersal dynamics, land bridges, endemism, biorealms.
- Island biogeography.
- Biomes, their distribution, principal biomes of the world.
- Detailed study of the paleoecology and biome types: tropical, temperate, grassland, desert, alpine tundra biomes with reference to India.

Internal assessment: 30

M.Sc Environmental Science

SEMESTER I

Foundation Course – I THE FRESH WATER HABITAT, THE MARINE HABITAT

Full Marks: 70+30 (100) **Exam Duration: 3 Hours** **Total Lectures:35**

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UNIT I THE FRESH WATER HABITAT (20)

- Lotic and lentic environments.
- Environmental condition of freshwaters, temperature cycles of lakes.
- Origin and classification of lakes. Classification of lakes on the basis of geography, circulation pattern, and stratification.
- Fertility of lakes.
- Habitat characteristics of lakes and zonation.
- Biological characteristics of lakes: neuston, plankton, nekton and benthos. Annual quantitative history of planktonic organisms; organisms inhabiting the weed beds.
- Food chain and energyflow.

UNIT II THE MARINE HABITAT (15)

- Structure of the ocean floor, zonation of the sea.
- Physical characteristics of the ocean environment.
- Chemical characteristics of the marine environment.
- Biological characteristics of the sea.
- Zonation of organisms in sandy and rocky shores.
- Deep sea adaptations.
- Food chain and energy flow in the marine environment.
- Brief idea of estuaries

Internal assessment: 30

M.Sc Environmental Science

SEMESTER I

Full Marks: 100
Exam Duration: 4 Hours

Core course – III PRACTAL

1..Measurement of various aquatic parameters (15)

- Determination of dissolved oxygen (Winkler's method) in a water sample.
- Determination of carbon dioxide of a water sample .
- Determination of alkalinity of a water sample.
- Determination of chloride in a water sample.

2. Measurement of nutrients in a water sample (15)
   - Determination of nitrate in a water sample.
   - . Determination of sulphate in a water sample.
   - Determination of phosphate in a water sample.

3. Measurement of productivity in a water body. (10)
   - Measurement of soil respiration.

4. Community analysis (10)
   - Species area curve using the quadrat method.
   - Calculation of species diversity in an aquatic community.
   - Bray-Curtis dissimilarity index

5. Knowledge of common ecological equipments, Adaptation and animal association studies
   6×5 (30)

6. Practical record (10)

7. Viva- voce (10)

M.Sc Environmental Science

SEMESTER II

Core Course-IV : POPULATION ATTRIBUTES, GROWTH AND INTERACTION, FUNDAMENTALS OF ENVIRONMENTAL CHEMISTRY. AND ENVIRONMENTAL PHYSICS:

Full Marks: (70+30) 100 **Exam Duration: 3 Hours** **Total Lectures: 25**

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UNIT- I: POPULATION ATTRIBUTES, GROWTH AND INTERACTION (15)

- Describing populations: natality,mortality, fecundity, survivorship curve, age structure.
- Population growth, carrying capacity and environmental resistance, logistic equation, J-shaped, and S-shaped growth curve. Cybernetic model.
- Population regulation: density dependent and density independentfactors.
- Intraspecific interaction: Nicholsons model, interspecific interaction: Gause'model.
- Prey-predator interaction: Lotka and Volterramodel.
- Host-parasitoid interaction: Nicholson- Bailey model.
- r and k-selected populations.
- Application of population studies: agriculture, fisheries, forestry.
- The world population scenario and the future impact on global resources.

UNIT-II: FUNDAMENTALS OF ENVIRONMENTAL CHEMISTRY (15)

- Basic concepts, valency, atomic weight, molecular weight; concentration of solutions: molarity, normality, equivalent weight, molality, density calculations, expression of analytical results.
- Chemical reactions, Gibb's free energy, equilibrium constant for dissociating species; acid-base equilibrium, pH scale.
- Salts of polyprotic acids, acid-base titrations, detection of end point, indicators, effect of acidity on the solubility of precipitate.
- Oxidation-reduction potential, Nernst equation, the glass pH electrode; buffers, buffering mechanism, conductivity.
- Beer's law.

FUNDAMENTALS OF ENVIRONMENTAL PHYSICS: (15)

- Force, weight and friction: gravitational force, centripetal and centrifugal force, velocity, acceleration, momentum, friction, surface tension.
- Work, power r and energy.
- Density and pressure: atmospheric pressure, measurement of pressure in pipelines.
- Heat and temperature, laws of thermodynamics.
- Hygrometry: vapour pressure, dew point, absolute and relative humidity, wet and dry bulb hygrometer.
- Gas laws: specific heat, lapse rate.
- Electromagnetic radiation and light: definition and units, measurement of irradiance in the aquatic environment. Measurement of turbidity.

Internal assessment: 30

M.Sc Environmental Science

SEMESTER II

Core Course-V : SOIL ENVIRONMENT ,ENVCIRONMENTAL MICROBIOLOGY,

QUANTITATIVE ANALYSIS OF DATA**, TOOLS,** TECHNIQUES AND ENVIRONMENTAL MICROBIOLOGY

There shall be seven questions in total. Question no. 1 is compulsory and span over the entire subject of this paper in the form of multiple choices / true or false / fills in the blanks with options etc and will carry 10 marks. From the rest 6 questions (3 from each group carrying 20 marks) examinees will be required to answer three, selecting not more than two from any group. Number of lectures is in parenthesis.

Full Marks: (70+30) 100 **Exam Duration: 3 Hours** **Total Lectures: 25**

UNIT- I: SOIL ENVIRONMENT (10)

- Soil formation (pedogenesis).
- Soil profile, soil types,soil characteristics (physical, chemical, and biological)
- Soil environment, soil biota.
- Food chain and energy flow in the soil habitat.

ENVIRONMENTAL MICROBIOLOGY:

- Chromatography: paper, TLC, HPLC.
- Ecological groups of microorganisms, microbial interactions(associations) plant-microbe associations, animal-microbe associations, microbe-microbe interactions; soil microbiology, water microbiology, aeromicrobilology.

UNIT- II: QUANTITATIVE ANALYSIS OF DATA (20)

- Basics of statistical tools: measures of central tendencies: summation, mean, median, mode.
- Measures of dispersion: sum of squared deviations, variance, standard deviation, standard error, confidence in estimating population mean, confidence limits, students t-test, selecting statistical sample size,
- Hypothesis testing. Test of significance or F-test, goodness of fit chi-square test.
- Correlation and regression:
- Percentage and powers, significant figures.
- Logarithms and exponential functions, natural logarithms, semi and double logarithmic plotting.
- Differentiation and integration, geometrical interpretation of a definite integral.
- Matrix algebra.

TOOLS, TECHNIQUES AND ENVIRONMENTAL MICROBIOLOGY (15)

- Principles and working of: pH meter, conductivity meter, DO meter, Hygrometer, Rain guage, Turbidimeter.
- Spectroscopy: common spectrophotometer, flame photometer, atomic absorption spectrophotometer.

Internal assessment: 30

M.Sc Environmental Science

SEMESTER II

Elective Course-I : WATER POLLUTION, LOCAL ENVIRONMENTAL ISSUES, AIR POLLUTION,GLOBAL ENVIRONMENTALISSUES

There shall be seven questions in total. Question no. 1 is compulsory and span over the entire subject of this paper in the form of multiple choices / true or false / fills in the blanks with options etc and will carry 10 marks. From the rest 6 questions (3 from each group carrying 20 marks) examinees will be required to answer three, selecting not more than two from any group. Number of lectures is in parenthesis.

Full Marks: (70+30) 100 **Exam Duration: 3 Hours** **Total Lectures: 25**

UNIT- I: WATER POLLUTION (15)

- Pollutants, types, entry of pollutants into the environment and biological systems. Stability, stress and strain. Bioaccumulation and Biomagnification.
- Ecological and biochemical aspects of water pollution: water quality parameters; criteria and standards. General effect of pollutants.
- Types and characteristics of domestic, industrial, agricultural, and sewage wastes – their effects on water bodies: chemical and bacteriological sampling and analysis.
- Waste water treatment, and control of water pollution.

LOCAL ENVIRONMENTAL ISSUES (15)

- Use of pesticides, biomagnification and problems.
- Fertilizers and eutrophication,
- Wetlands and wastelands and their management.
- Photochemical smog;
- Deforestation and movements in india: chipko, appiko, silent valley project,mega dams and environmental issues, pollution and its impact with reference to India.
- Resource use and its impact on biogeochemical cycling;
- Habitat loss, fragmentation, degradation and its impact on biodiversity;acid rains; salinization

UNIT II AIR POLLUTION (20)

- Evolution of the earth's atmosphere, structure of the atmosphere, composition of the atmosphere.
- Air pollution: dispersion and fate of atmospheric pollutants, sources: point and non-point sources; primary air pollutants and ambient air quality standards.
- Sources, effects and control measures of the following air pollutants: suspended particulate matter, carbon monoxide, oxides of nitrogen, oxides of sulphur, photochemical smog.
- Assessment of air pollution. Indoor air pollution.
- Global air pollution problems: acid rains, ozone problem, global warming.

GLOBAL ENVIRONMENTALISSUES (15)

- The ozone problem.
- Global warming and climate change, carbon sinks, forests and climate change, El Nino, La Nina and climate change; coral bleaching. Climate change and its effect on biodiversity; loss of biodiversity and extinction.
- Global energy security; stress on the environment society and resources; human population problem-the number game.
- Natural disasters: earthquakes, hurricanes and floods; genetically engineered food; third world debt and disaster recovery.
- Economics and environment. Climate, justice and equity.

Internal assessment: 30

M.Sc Environmental Science
SEMESTER II

Full Marks: 100
Exam Duration: 3 Hours

Core course- VI: PRACTICAL

1. Aquatic (10)

- Measurement of conductivity of a water sample.
- Measurement of pH by a pH meter of a water or soil sample.
- Measurement of total hardness of a water sample. (10)
- . Measurement of silicate using a spectrophotometer.

2. Soil (10)

- Measurement of water holding capacity of soil.
- . Measurement of soil organic matter.
- Determination of available phosphorus.
- Determination of soil nitrate.

3. Plankton

- Qualitative and quantitative analysis of plankton (20)
- Importance value index

4. Quantitative analysis from datasets (10)

- Co-relation, Regression simple
- Multiple regression
- Species diversity calculation from plankton data

5. .Tools and techniques
Working principle of: Spectrophotometer, pH meter, Conductivity meter, DO meter, Ekman's dredge (20)

7. Sessional work (10)

8. . Viva-voce (10)

M.Sc Environmental Science

SEMESTER III

Core Course-VII : SOIL POLLUTION, NOISE POLLUTION, RADIATION POLLUTION AND ENVIRONMENTAL BIOTECHNOLOGY

There shall be seven questions in total. Question no. 1 is compulsory and span over the entire subject of this paper in the form of multiple choices / true or false / fills in the blanks with options etc and will carry 10 marks. From the rest 6 questions (3 from each group carrying 20 marks) examinees will be required to answer three, selecting not more than two from any group. Number of lectures is in parenthesis.

Full Marks: (70+30) 100 **Exam Duration: 3 Hours** **Total Lectures: 25**

UNIT- I: SOIL POLLUTION AND NOISE POLLUTION (10)

- Transport and behavior of soil pollutants.
- Sources of spoil pollutants: industrial waste, urban waste, hospital wastes, agricultural wastes (fertilizers, pesticides), radioactive wastes.
- Effects of soil pollutants, prevention and control of soil pollution, solid waste management and strategies., assessment of soil pollutions, international standards.
- Biotechnological methods of waste treatment
- Nature of sound, sound level and decibel scales, noise pollution assessment, control measures and management strategies, indoor noise pollution and control, transport noise and control.

UNIT - II : RADIATION POLLUTION AND ENVIRONMENTAL BIOTECHNOLOGY (15)

- Radioactive emission and ionizing radiations, units of radioactivity and measurement of toxic dose, radioactive processes in use: natural and man-made radiations, effect of radiations on man, ecosystems, and aquatic organisms. Control and management of radiation pollution.
- Growth and demand for environmental biotechnologies for cleaner processes, bioremediation of soil and water, environmental oil biocatalysts, cleaner technology through microbial processes, novel bioinsecticides, genetically engineered microorganisms in biotechnological processes, bioprobes.

Internal Assessment 30 Marks

M.Sc Environmental Science

SEMESTER III

Core Course-VIII : TOXICOLOGY AND TOXICANTS, EFFECTS OF TOXICANTS AND THEIR ASSESSMENT

There shall be seven questions in total. Question no. 1 is compulsory and span over the entire subject of this paper in the form of multiple choices / true or false / fills in the blanks with options etc and will carry 10 marks. From the rest 6 questions (3 from each group carrying 20 marks) examinees will be required to answer three, selecting not more than two from any group. Number of lectures is in parenthesis.

Full Marks: (70+30) 100 **Exam Duration: 3 Hours** **Total Lectures: 25**

UNIT-I TOXICOLOGY AND TOXICANTS (15)

- Introduction, classification, framework for environmental toxicology.
- Toxic agents: pesticides, metals, radiations, carcinogens, heavy metals and poisons, mode of action of toxicants, routes of entry, accumulation of toxicants, bioaccumulation, biomagnifications.
- Various types of interactions. Factors affecting toxicity.
- Biotransformation of toxicants, biodegradation

UNIT –II EFFECTS OF TOXICANTS AND ASSESSMENT (15)

- Effect of toxic substances on organisms, types of effects: physiological, behavioural, mutagenic, teratogenic. Effects at the cellular level.
- Genotoxicology, human toxicology, occupational safety and health administration.
- Toxicological testing methods. Assessment of toxicity: LD_{50}, $LT_{50,}$
- Statistical methods, probit units, toxic dose, dose- response relationship.
- Biomonitoring, bioindicators (indicator species).
- Environmental and occupational Health.

Internal assessment: 30

M.Sc Environmental Science

SEMESTER III

Elective Course-II : WATER MANAGEMENT: ENTRY OF POLLUTANTS AND ITS IMPACT BASIC HYDROLOGICAL CONCEPT

There shall be seven questions in total. Question no. 1 is compulsory and span over the entire subject of this paper in the form of multiple choices / true or false / fills in the blanks with options etc and will carry 10 marks. From the rest 6 questions (3 from each group carrying 20 marks) examinees will be required to answer three, selecting not more than two from any group. Number of lectures is in parenthesis.

Full Marks: (70+30) 100 **Exam Duration: 3 Hours** **Total Lectures: 25**

UNIT- I: BASIC HYDROLOGICAL CONCEPTS: (20)

- The characteristics of water.
- Rivers and lakes- their distribution, origin and forms(with reference to India).
- The hydrological cycle, and global water balance.
- Factors influencing the inland waters (light and heat); Water movements;
- Streams their origin and hydrodynamics.
- Ground water levels and Environmental influences.
- Major physical and chemical factors (light, temperature, gases, nutrients).
- Aquatic biota: phytoplankton, zooplankton, benthos, periphyton, macrophytes, fish and other animals. Primary production in lakes, rivers, estuaries and wetlands.
- Nutrient dynamics in lakes and rivers.
- Impact of man on water resources.
- Paleolimnology: Ontogeny of inland aquatic systems; Natural eutrophication.

UNIT- II ENTRY OF POLLUTANTS AND ITS IMPACT (15)

- Types of pollutants, entry of pollutants into the aquatic environment and biological systems.
- Stability stress and strain, bioaccumulation and biomagnification, models of pollutant movement through the aquatic food chain.
- Water pollution: natural qualities of water, national and international standards; types of pollution: industrial, organic, thermal; effects of pollutants: heavy metals, inorganic reducing agents, heated effluents, organic pollutants.
- Cultural eutrophication and its impact on inland waters.

Internal assessment: 30

OR
M.Sc Environmental Science

SEMESTER III

Elective Course-II : ENVIRONMENTAL MANAGEMENT: STRATEGIES FOR ENVIRONMENTAL MANAGEMENT, STRENGTHENING THE ROLE OF MAJOR GROUPS AND MEANS OF IMPLEMENTATION

There shall be seven questions in total. Question no. 1 is compulsory and span over the entire subject of this paper in the form of multiple choices / true or false / fills in the blanks with options etc and will carry 10 marks. From the rest 6 questions (3 from each group carrying 20 marks) examinees will be required to answer three, selecting not more than two from any group. Number of lectures is in parenthesis.

Full Marks: (70+30) 100 **Exam Duration: 3 Hours** **Total Lectures: 25**

UNIT-I: STRATEGIES FOR ENVIRONMENTAL MANAGEMENT (15)

- Sustainable development; International cooperation to accelerate sustainable development in developing countries.
- Population dynamics and sustainability.
- Integrating environment and decision making.
- Protecting the environment; integrated approach to the planning and management of land resources; combating deforestation; managing fragile ecosystems; protection of the oceans.
- Management of solid and hazardous wastes.
- Protection ofthe quality and supply of freshwaters.

UNIT- II: STRENGTHENING THE ROLE OF MAJOR GROUPS AND MEANS OF IMPLEMENTATION (20)

- Global action of women towards sustainable development.
- Financial resources and mechanisms.
- Promoting environmental education and awareness.
- Transfer of environmentally sound technology;
- Environmentally sound management of biotechnology
- Strengthening the role of farmers; promoting sustainable agriculture and rural development.
- Management of biodiversity; global campaigns and peoples movement to save the environment.
- Global conferences to combat environmental problems (COP_3-COP_{15});environment and health

Internal assessment: 30

M.Sc Environmental Science

SEMESTER III

Full Marks: 100

Exam Duration: 3Hours

Core Course –IX PRACTICAL

1.Statistical analysis of data on toxicology 15

2. Determination of suspended particulate matters in the atmosphere. 20

3. Determination of phosphate or chloride in water sample. 15

4. Working and principle of :respirable dust sampler, high volume sampler, spectrophotometer, BOD chamber. 30

5.Sessional work 10

6.Viva-voce 10

M.Sc Environmental Science

SEMESTER IV

Core Course-X : ENVIRONMENTAL IMPACT ASSESSMENT, CONSEVATION OF WATER, SOIL, FORESTS & ,ENERGY; ENVIRONMENTAL POLICY; ENVIRONMENTAL ETHICS AND ENVIRONMENTAL LAW; **NATURAL RESOURCES CONSERVATION AND MANAGEMENT,**

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Full Marks: (70+30) 100 **Exam Duration: 3 Hours** **Total Lectures: 25**

UNIT- I: ENVIRONMENTAL IMPACT ASSESSMENT (15)

- Introduction. The need for EIA, the EIA process, preliminary proposal, initial discussion and public participation, formal proposal.
- Screening, impact identification, scoping, impact forecasting, final report-environmental impact statement, monitoring of environmental impacts, environmental auditing, environmental legislation.

CONSEVATION OF WATER, SOIL, FORESTS, ENERGY (15)

- Natural resources, types, uncontrolled resource utilization: the cause of concern,
- Areas of concern: deforestation, soil erosion, desertification, pollution and eutrophication, over exploitation of selected species, destruction for commercial purposes, development of a fuel powered urban-industrial society, threat of war, destruction of biodiversity.
- Management strategies and sustainable development.
- Conservation of forests, social forestry; soil conservation; conservation of energy.
- Conservation of biodiversity.

UNIT- II: ENVIRONMENTAL POLICY (15)

- Introduction; the earth summit; environmental change.
- The nationalenvironmental policy: forest management policy; policy on the conservation of biodiversity; the water management policy; policy on the prevention of pollution and management; policy on environmental awareness and education; policy on energy.

ENVIRONMENTAL ETHICS AND ENVIRONMENTAL LAW (15)

- Environmental ethics.

- The Indian Wildlife (Protection) Act, 1972, amended 1993; No. 16 of 2003, [17/1/2003] The Wild Life (Protection) Amendment Act, 2002; S.O.1085(E), [30/9/2002] - The National Wildlife Action Plan.Forest (Conservation) Act, 1980, amended 1988**;**
- Mines and minerals (development and regulation) act, 1957;S.O.24(E), [6/1/2000] –
- The Hazardous Wastes (Management and Handling) Amendment Rules, 2000;S.O.698(E), [17/6/2003] –
- The Recycled Plastics Manufacture and Usage (Amendment) Rules, 2003; G.S.R.347(E), [1/8/1996] –
- The Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996;S.O.1069(E), (17/9/2003)
- Bio-Medical Waste (Management and Handling) (Amendment) Rules, 2003;
- The water (prevention and control of pollution) cess Act, 1977;The air (prevention and control of pollution) Act, 1981;S.O.123(E), [14/2/2000] –
- Noise Pollution (Regulation and Control) Rules, 2000;
- The environment (protection) Act, 1986;
- The Scheme on Labeling of Environment Friendly Products (ECOMARK).S.O.195(E), [19/01/2009] –
- Environmental Impact Assessment Notification-2009. (**Internal assessment 30 Marks)**

M.Sc Environmental Science

SEMESTER IV

Elective Course-III : WATER RESOURCES: POLLUTION ASSESSMENT, CONTROL AND MANAGEMENT : POLLUTION ASSESSMENT AND CONTROL, CONSERVATION AND MANAGEMENT OF WATER RESOURCES

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Full Marks: (70+30) 100 **Exam Duration: 3 Hours** **Total Lectures: 25**

UNIT- I: POLLUTION ASSESSMENT AND CONTROL (15)

- The oxygen balance in rivers and the impact of pollutants. Oxygen sag, reaeration, self-purification. Impact assessment.
- Assessment of pollution: BOD, COD, NOD, UOD, Coliform counts (MPN index).
- Biochemical assessment Indicator species (bio indicators), MPN index, knowledge of the saprobian system and the saprobian index.
- Eutrophication.
- Control of water pollution: primary, secondary and tertiary treatment, macrophyte based sewage treatment system (MSTS). Management strategies in protection and conservation of water.
- The Ganga and Yamuna action plan.

UNIT- II: CONSERVATION AND MANAGEMENT OF WATER RESOURCES (15)

- Management strategies in water protection and conservation.
- Project formulation, environmental considerations, multi-purpose project.
- Conservation of water, rain water harvesting. National water policy: Salient features.
- Reclamation and conservation of wetlands.
- Modeling environmental impact assessment from case studies: the silent valley project; the Hubbard brook experience.
- Preparation of network diagrams to study impact of processes; mega dams and their impact on the environment.
- Pollution and its impact on the environment.
- Preparation of interaction matrix to show the relation between various parameters.

Internal assessment: 30 Marks

OR
M.Sc Environmental Science

SEMESTER IV

Elective Course-III : ENVIRONMENTAL MANAGEMENT: MODELING EIA; CONSERVATION AND MANAGEMENT OF BIODIVERSITY

There shall be seven questions in total. Question no. 1 is compulsory and span over the entire subject of this paper in the form of multiple choices / true or false / fills in the blanks with options etc and will carry 10 marks. From the rest 6 questions (3 from each group carrying 20 marks) examinees will be required to answer three, selecting not more than two from any group. Number of lectures is in parenthesis.

Full Marks: (70+30) 100 **Exam Duration: 3 Hours** **Total Lectures: 30**

UNIT- I: MODELING EIA (15)

- Modeling global impacts for control and management.
- Mining and its impact on the environment.
- Resource use and its impact on the environment.
- Urbanization and its impact on the environment.
- agriculture and its impact on the environment.
- Deforestation and its impact on the environment.
- Case studies: river valley projects; thermal power plants: mining projects; oil refineries and petrochemicals; tourism coastal zone development

UNIT- II: CONSERVATION AND MANAGEMENT OF BIODIVERSITY (15)

- Biodiversity, levels of biodiversity: ecological, evolutionary, genetic; types of biodiversity.
- Distribution, significance of biodiversity.
- Reduction of biodiversity.
- Conservation and management of biodiversity: need, steps, in-situ and ex-situ, and inter-situ conservation.
- Management strategies: national parks, sanctuaries, botanic gardens, gene banks. IUCN categorization of threatened species. Wild life management.

Internal assessment: 30

M.Sc Environmental Science

SEMESTER IV

Full Marks: 100

Exam Duration: 3 Hours

Elective Course –IV PRACTICAL

1. Assessment of water pollution (30)

- Determination of BOD
- Determination of COD
- Determination of DOM

2.. Determination of pollutants (30)

- Determination of detergents
- Determination of fluorides
- Determination of MPN index
- Determination of chlorophyll

3. Statistical analysis of data on toxicology (20)

4. Sessional work (10)

5. Viva-voce (10)

M.Sc. Environmental Science

SEMESTER IV

Full Marks: 100

Exam Duration: 3 Hours

Practical

PROJECT WORK

Students can take up any project from the list mentioned below or they may develop their own innovative projects on environmental aspects:

Project development in coordination with environmental institution, agricultural institutions, nearby industries, central institutes and other NGO organizations. Students will be required to provide an explicit presentation of their work which will be certified by the concerned institution from which the training has been taken.

1. **Basic ecosystem dynamics (productivity, energy flow, biogeochemical cycling, population dynamics)**
2. **Different aspects of pollution.**
3. **Environmental impact of mining projects.**
4. **Environmental impact of industrial projects.**
5. **Environmental impact of deforestation.**
6. **Impact of population increase on water resources.**
7. **Ground water recharge systems.**
8. **Impact of automobiles on the environment.**
9. **Creating environmental awareness among the local population.**
10. **Providing environmental education to the people.**
11. **Study of the age structure of the population of a particular area.**
12. **Project on mathematical modeling of environmental aspects.**
13. **Environmental biotechnology.**
14. **Environmental management.**

The marks will be distributed as follows: 50 marks for the project report, 25 for written examination and 25 marks for viva-voce.

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Suggested Readings

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Margulis, L. and Lovelock, J.E. 1981: Atmosphere and evolution. In: Life in the Universe (Billingham, J. ed.). M.L.T. Press, Cambridge, Massachusetts.

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NEERI, 1989: Manual bon analytical instrumentation in environmental engineering. NEERI, Nagpur.
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Pentecost, A. 1984: Introduction to freshwater algae. Richmond Publication Company, Richmond

Postgate, J.R 1987: Nitrogen fixation. Edward Arnold, London.

Simmons, I.G. 1981: The ecology of natural resources. Edward Arnold, London.

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Tait, R.V. 1978: Elements of marine ecology. Butterworths, London.

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Wetzel, R.G.2001: Limnology. Academic press. USA.

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