

**DEPARTMENT OF ENVIRONMENTAL SCIENCE**

Session: 2016-17

M. Sc. Environmental Science

Credit matrix for M.Sc. Environment Science Program

| Semester     | Hard Core | Soft Core | Interdisciplinary | Foundation course | Dissertation | Total |
|--------------|-----------|-----------|-------------------|-------------------|--------------|-------|
| <b>I</b>     | 20T+8P    | -         | -                 | -                 | -            | 28    |
| <b>II</b>    | 12T+6P    | 4+2P      | 3                 | 2                 | -            | 29    |
| <b>III</b>   | 8P+4P     | 8T+4P     | 3                 | -                 | -            | 27    |
| <b>IV</b>    | 8T        | -         | -                 | -                 | 20           | 28    |
| <b>Total</b> | 66        | 18        | 6                 | 2                 | 20           | 112   |

**Scheme of M.Sc. Environmental Science Program****SEMESTER-1**

| S.No. | Course No. | Nomenclature of Paper             | L-T-P (Hours) | Credits | Evaluation Scheme |    |       |
|-------|------------|-----------------------------------|---------------|---------|-------------------|----|-------|
|       |            |                                   |               |         | Theory            | IA | Total |
| 1     | 16ENV21C1  | Environmental Toxicology          | 4-0-0         | 4       | 80                | 20 | 100   |
| 2     | 16ENV21C2  | Environmental Biology             | 4-0-0         | 4       | 80                | 20 | 100   |
| 3     | 16ENV21C3  | Analytical Techniques             | 4-0-0         | 4       | 80                | 20 | 100   |
| 4     | 16ENV21C4  | Environmental Pollution           | 4-0-0         | 4       | 80                | 20 | 100   |
| 5     | 16ENV21C5  | Solid waste Management            | 4-0-0         | 4       | 80                | 20 | 100   |
| 6     | 16ENV21C6  | Lab Course-I<br>(16ENV21C1,2 & 3) | 0-0-8         | 4       | -                 | -  | 100   |
| 7     | 16ENV21C7  | Lab Course-II<br>(16ENV21C4 & 5)  | 0-0-8         | 4       | -                 | -  | 100   |

Total Credits: 28

Total Marks: 700

**SEMESTER-2**

| S.No. | Course No.                                       | Nomenclature of Paper   | L-T-P (Hours) | Credits | Evaluation Scheme |    |       |
|-------|--|---|---------------|---------|-------------------|----|-------|
|       |  |   |               |         | Theory            | IA | Total |
| 1     | 16ENV22C1  | Natural Resources   | 4-0-0         | 4       | 80                | 20 | 100   |
| 2     | 16ENV22C2  | Biodiversity  | 4-0-0         | 4       | 80                | 20 | 100   |
| 3     | 16ENV22C3  | Biostatistics & Environmental Modeling  | 4-0-0         | 4       | 80                | 20 | 100   |
| 4     | 16ENV22C4  | Lab Course-III<br>(16ENV22C1,2 & 3)   | 0-0-12        | 6       | -                 | -  | 150   |
| 5     | 16ENV22D1<br>16ENV22D2<br>16ENV22D3<br>16ENV22D4 | Waste water treatment Technology<br>Environmental Geology<br>Resource Management<br>Concept of Biochemistry | 4-0-0         | 4       | 80                | 20 | 100   |
| 6     | 16ENV22D5  | Lab Course-IV<br>(16ENV22D1/2/3/4)  | 0-0-4         | 2       | -                 | -  | 50    |
| 7     |  | Foundation Course   | 2-0-0         | 2       | 40                | 10 | 50    |
| 8     | 16ENVO1  | Open Elective   | 3-0-0         | 3       | 80                | 20 | 100   |

Total Credits: 29  
Total Marks: 750

### SEMESTER-3

| S.No. | Course No.                          | Nomenclature of Paper  | L-T-P<br>(Hours) | Credits | Evaluation Scheme |    |             |
|-------|-------------------------------------|--|------------------|---------|-------------------|----|-------------|
|       |                                     |  |                  |         | Theory            | IA | Total marks |
| 1     | 16ENV23C1                           | Environmental Chemistry  | 4-0-0            | 4       | 80                | 20 | 100         |
| 2     | 16ENV23C2                           | Remote Sensing and Geographical Information System                             | 4-0-0            | 4       | 80                | 20 | 100         |
| 3     | 16ENV23C3                           | Lab Course-V<br>(16ENV23C1&2)  | 0-0-8            | 4       | -                 | -  | 100         |
| 4     | 16ENV23D1<br>16ENV23D2<br>16ENV23D3 | Environment Impact Assessment<br>Bioremediation<br>Agriculture and Environment | 4-0-0            | 4       | 80                | 20 | 100         |
| 5     | 16ENV23D4<br>16ENV23D5              | Elementary concept of Physical Environment<br>Environmental Microbiology       | 4-0-0            | 4       | 80                | 20 | 100         |
| 6     | 16ENV23D6                           | Lab Course-VI<br>(16ENV23D1/2/3 & 4/5)   | 0-0-8            | 4       | -                 | -  | 100         |
| 7     | 16ENVO2                             | Open Elective  | 3-0-0            | 3       | 80                | 20 | 100         |

Total Credits: 27  
Total Marks: 700

### SEMESTER-4

| S.No. | Course No. | Nomenclature of Paper               | L-T-P<br>(Hours) | Credits | Evaluation Scheme |    |             |
|-------|------------|-------------------------------------|------------------|---------|-------------------|----|-------------|
|       |            |                                     |                  |         | Theory            | IA | Total marks |
| 1     | 16ENV24C1  | Environmental laws                  | 4-0-0            | 4       | 80                | 20 | 100         |
| 2     | 16ENV24C2  | Environmental Management & Planning | 4-0-0            | 4       | 80                | 20 | 100         |
| 3     | 16ENV24C3  | Dissertation                        | 0-0-40           | 20      | -                 | -  | 300         |

Total Credits: 28  
Total Marks: 500  
Grand Total Marks-2650  
Grand Total Credits – 112

- **Core Courses:** In every semester the students have to compulsorily study these courses to complete the requirement of the programme.
- **Discipline Specific Elective Course:** This course has to be chosen by the student from the given program elective papers and its respective lab course during II<sup>nd</sup> and III<sup>rd</sup> semester.

- **Foundation Course:** The students are required to select one foundation elective course in II<sup>nd</sup> semester of their choice from any other Department in the M.D. university campus.
- **Open Elective:** The students are required to have one open elective paper in II<sup>nd</sup> & III<sup>rd</sup> semester of their choice from any other M.Sc. course/Department in the M.D. university campus.
- The candidate shall be required to undergo Summer Training (4-5 weeks) at the end of II<sup>nd</sup> semester. She/he will be required to submit a comprehensive report before the commencement of the III<sup>rd</sup> semester examination. The evaluation of the training report will be based on the Presentation on the Training Report by the candidate in the department.
- In the IV<sup>th</sup> semester, the student will carry out dissertation work and the report has to be submitted by 30<sup>th</sup> June. The evaluation of the dissertation will be done by external examiner (approved by VC from the panel approved in PGBOS) and the internal examiner. Any Patent/IPR based on dissertation report will be in the name of MDU, student and the guide as inventor.

# M.Sc. Environmental Sciences

## Semester-I

### 16ENV21C1 – Environmental Toxicology

Max. Marks : 80

Time : 3 Hours.

**Note :** 1. Nine questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question 1 and four by selecting one from each section.

#### Unit - I

Toxic chemicals in the environment - air, water & their effects, Pesticides in water, Biochemicals aspects of arsenic, cadmium, lead mercury, carbon monoxide, ozone and PAN pesticide.

#### Unit - 2

Mode of entry of toxic substance, Process of biotransformation of xenobiotics, Carcinogens in air, chemical carcinogenicity, mechanism of carcinogenicity, Environmental carcinogenicity testing.

#### Unit - 3

Insecticides, MIC effects, Concept of major, trace and Rare Earth Element (REE)- possible effects of imbalance of some trace elements and human health, classification of trace elements, Mobility of trace elements.

#### Unit- 4

Biogeochemical factors in environmental health, Epidemiological issues goiter, fluorosis, arsenic poisoning, Diseases induced by human use of land.

#### References :

1. Environmental chemistry - Sodhi
2. Principals of Environmental chemistry - Manhan
3. Environmental hazards & human health R.B. Philip
4. Toxicology - principles & applications - Niesink & Jon devries
5. Parasitology - Chatterjee
6. Preventive & Social medicines – Perk

## **16ENV21C2 Environmental Biology**

Max. Marks : 80

Time : 3 Hours.

**Note:** 1. Nine questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting one from each section.

### **UNIT - I**

Definition, principles and scope of ecology, human ecology and human settlements, evolution, origin of life and speciation, Ecosystem stability-cybernetics and ecosystem regulation, evolution of biosphere.

### **UNIT - II**

Ecosystem structure and functions, abiotic and biotic component, Energy flow, food chain, food web, Ecological Pyramids-types, biogeochemical cycles, ecological succession, Ecads and ecotypes.

### **UNIT - III**

Population ecology- density, natality, mortality, survivorship curves, age distribution, growth curves and models, r & k selection, population interactions- Mutualism, Parasitism, Predator-Prey relations, System Theory and Ecological Model.

### **UNIT - IV**

Earth's major ecosystem - terrestrial and aquatic ecosystem, soil microorganism and their functions, coastal management, criteria employed for disposal of pollutants in marine ecosystem, coastal water system and man-made reservoirs, biology and ecology of reservoirs.

### **References**

1. Basic ecology - E. P. Odum
2. Ecology and field biology - R.L. Smith
3. Ecology - P.D. Sharma
4. Fundamentals of ecology -E.P. Odum
5. Principles of ecology – Rickleff

## **16ENV21C3 Analytical Techniques**

Max. Marks : 80

Time : 3 Hours.

**Note :** 1. Nine questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question 1 and four by selecting one from each section.

### **Unit - I**

Principles and application of Spectrophotometry (UV-Visible spectrophotometry), Titrimetry, Gravimetry, Colourimetry, NMR, ESR, Microscopy-phase, light and fluorescence microscopes, Scanning and Transmission electron microscopes.

### **Unit - 2**

Chromatographic techniques (Paper chromatography, thin layer chromatography, ion exchange chromatography, Column chromatography), Atomic absorption spectrophotometry, cytophotometry and flow cytometry, Fixation and staining, Principles and techniques of nucleic acid hybridization and Cot curves, Plasma emission spectroscopy.

### **Unit - 3**

Electrophoresis, solid and liquid scintillation, X-ray fluorescence, X-ray diffraction. Flame photometry, Gas-liquid chromatography, High pressure liquid chromatography – auto radiography, Ultracentrifugation.

### **Unit- 4**

Methods for measuring nucleic acid and protein interactions, DNA finger printing Molecular markers RFLP, AFLP, RAPD, Sequencing of proteins and nucleic acids, southern, northern, western blotting techniques, PCR polymerase chain reaction.

### **References :**

1. Principles of Biophysical chemistry - Uppadahay -Uppadahay and Nath.
2. Analytical Techniques - S.K. Sahani

## **16ENV21C4 Environmental Pollution**

Max. Marks : 80  
Time : 3 Hours.

**Note:** 1. Nine questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question 1 and four by selecting one from each section.

### **UNIT - I**

Air pollution- natural and anthropogenic sources of pollution, primary and secondary pollutants, transport and diffusion of pollutants, gas laws governing the behaviour of pollutants in the atmosphere, Methods of monitoring and control of air pollution, SO<sub>2</sub>, NO<sub>x</sub>, CO, SPM.

### **UNIT - II**

Water pollution - types sources and consequences of water pollution, physico-chemical and bacteriological sampling, Analysis of water quality, standards, sewage and wastewater treatment and recycling, water quality and standards.

### **UNIT - III**

Soil pollution chemical and bacteriological sampling as analysis of soil quality, soil pollution control, industrial waste effluents and heavy metals and their interactions with soil components.

### **UNIT - IV**

Noise pollution - sources of noise pollution, measurement and indices, Marine pollution, sources of marine pollution and its control, Effects of pollutants on human beings, plants, animals and climate, air quality standards and air pollution.

### **References**

1. Air pollution and control - K.V.S.G. Murlikrishan
2. Industrial noise control - Bell & Bell
3. Environmental engineering -Peary
4. Introduction to environmental engineering and science- Gilbert Masters.

## **16ENV21C5 Solid Waste Management**

Max. Marks : 80  
Time : 3 Hours.

**Note :** 1. Nine questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question 1 and four by selecting one from each section.

### **Unit - I**

Sources, generation, classification & composition of solid wastes. Solid waste management methods - Sanitary land filling, Composting, Vermi composting, incineration and burial, energy recovery from organic waste.

### **Unit - 2**

Solid Waste Management Plan, Waste minimization technologies, Hazardous Waste Management, Sources & Classification, physicochemical properties, Hazardous Waste Control & Treatment.

### **Unit - 3**

Hospital Waste Management. Hazardous Waste Management & Handling rules, 1989 & 2000 (amendments), Recycling of waste materials, Garbage gravel yards.

### **Unit- 4**

Disaster Management and Risk analysis, Fly ash generation & utilization, Primary, secondary & tertiary & advance treatment of various effluents, Beverage container deposit Bill.

### **References :**

1. Solid Waste Management CPCB. New Delhi.
2. Ecotechnology for pollution control & environmental management - By R.K. Trivedi & Arvind Kr.
3. Basic Environmental Technology - J.A. Nathanson



## **Semester –II**

### **16ENV22C1 Natural Resources**

Max. Marks : 80

Time : 3 Hours.

**Note:** 1. Nine questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting one from each section.

#### **UNIT - I**

Sun as a source of energy, solar radiations and its spectral characteristics fossil fuels classification, composition, physico- chemical characteristics and energy content of coal, petroleum and Natural gas.

#### **UNIT - II**

Principles of generation of hydroelectric power, tidal power, thermal energy conversion, wind, geo thermal energy, solar collectors, photovoltaic, solar ponds, oceans, Soil microorganisms and their functions, Carbon credits.

#### **UNIT - III**

Nuclear energy- fission and fusion, bio energy -energy from biomass and biogas, anaerobic digestion, energy use patterns in different parts of the world. Impacts of large scale exploitation of solar, wind, hydro and ocean energy.

#### **UNIT - IV**

Mineral resources and reserves, ocean ore and recycling of resources, Environmental impact of exploitation, processing and smelting of Mineral, oceans as need areas for exploitation of Mineral resources.

#### **References**

1. Living in the environmental - T.J. Miller.
2. Natural resource conservation - Owen & Chiras.
3. Encyclopedia Energy - I & II.

## **16ENV22C2 Biodiversity**

Max. Marks : 80

Time : 3 Hours.

**Note :** 1. Nine questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question 1 and four by selecting one from each section.

### **Unit - I**

Biodiversity - definition, hot spots of Biodiversity, strategies for Biodiversity Conservation, National Parks, Sanctuaries and Biosphere reserves, gene pool, Sustainable development, Habitat.

### **Unit - 2**

Aquatic common flora and fauna in India - phytoplankton, zooplankton and macrophytes, terrestrial common flora and fauna in India - forests, endangered and threatened species.

### **Unit - 3**

Strategies for Biodiversity Conservation, cryopreservation, gene banks, tissue culture and artificial seed technology, new seed development policy 1988, conservation of medicinal plants.

### **Unit- 4**

International conventions, treaties and protocols for Biodiversity Conservation, Biodiversity in the welfare of mankind, Species concept, Biological nomenclature theories of biological classification.

### **References :**

1. Global Biodiversity - W.R. L.IUCN
2. Ecology of natural resource - Ramade
3. Ecology - P.D. Sharma

## **16ENV22C3 Biostatistics and Environmental modelling**

Max. Marks : 80  
Time : 3 Hours.

**Note:** 1. Nine questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting one from each section.

### **UNIT - I**

Measurement of central tendency - mean (Geometric and Harmonic), median, mode, Measurement of dispersion moments, standard deviation, skewness and kurtosis, Correlation and linear regression of one independent variable, Basic laws and concepts of probability

### **UNIT - II**

Definition of random variable, density function, Basic concepts of binomial and normal distributions. Sampling measurement and distribution of attributes, moments, matrices and simultaneous linear equations, tests of hypothesis and significance.

### **UNIT - III**

Role of modelling in environmental sciences, Model classification deterministic models, stochastic models, steady state models, dynamic models, different stages involved in model building. Simple microbial growth kinetics monod equation, methods for formulation of dynamic balance equations mass balance procedures.

### **UNIT - IV**

Models of population growth and interactions Lotka Volterra model, Leslies matrix model, Point source stream pollution, Box model, Gaussian plume model, Linear, simple and multiple regression models, validation and forecasting.

### **References**

1. Dynamics of Environmental Bioprocesses-Modelling and simulation-Snape and Dunn.
2. Environmental Modeling – Jorgensen

## **16ENV22D1 Waste Water Treatment Technology**

**M.M. : 80**  
**Time : 3 Hrs.**

**Note:** 1. Nine questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting one from each section.

### **Unit-I**

Overview of standards of water quality in relation to public health - Potable and nonpotable water; Methods of water sampling for pollution analysis. Principal forms of Water Pollutants and their sources; Pollution of stream, lakes and phenomenon of eutrophication; Ocean pollution – oil pollution; Ground water pollution and its control; Water pollution prevention.

### **Unit II**

Methods of monitoring Pollution; Biological methods; Detection methods for DO, BOD, Pathogen monitoring by heterotrophic plate count; Multiple tube method; Membrane filtration methods; Other emerging techniques such as enzyme detection, hybridization, PCR, Gene probe technology etc.; Strategies for controlling pathogen transfer; Chemical methods- Detection methods for COD, pH, alkalinity, TSS, TDS, Total organic carbon, oil, grease etc.; Biosensors for pollution

### **Unit III**

Sewage and waste water treatments systems, Primary, secondary and tertiary treatments, Biological treatments - aerobic versus anaerobic treatments; Environmental pollution control- Bioremediation, Bioaugmentation and Biostimulation; Biofilms in treatment of waste water; Bioreactors for waste water treatments.

### **Unit IV**

Physicochemical characteristics and treatment strategies for effluent generated by Distillary and fermentation industry; Fertilizers and pesticide manufacturing industries; Dyes and textile industries; Paper and pulp industries; Tanneries; Pharmaceuticals; Thermal power plants; Food and dairy industries; Iron and steel industries; Organic solvents; Chlorinated minerals and inorganic chemical industries and petrochemicals.

### **References**

1. Nicolas P Cherewsinott, Handbook of water and waste water Treatment Technology, Boston Oxford Auckland Johannesburg Melbourne, New Delhi
2. Frederick W Pontinus, Water Quality and Treatment. American water works Association, MC Graw Hill Inc.
3. S K Agarwal, Water Pollution, APH Publishing Corporation.
4. Ronald L Dooste, Theory and Practical of water and waste water Treatment.
5. Bill T. Ray, Environmental Engineering, PWS Publishing company.

## **16ENV22D2 Environmental Geology**

Max. Marks : 80  
Time : 3 Hours.

**Note:** 1. Nine questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting one from each section.

### **UNIT - I**

Earth processes, Geological cycle, Tectonic cycle, Rock cycle, Hydrological cycle, Biogeochemical cycles, Special problems of time and scale in geology, concept of residence time and rates of natural cycles.

### **UNIT - II**

Catastrophic geological hazards, Prediction and perception of the hazards and adjustment to hazardous activities. Predictions and perception of hazard and adjustment to hazardous activities.

### **UNIT - III**

River flooding- causes, nature and frequency of floods. Landslides- causes, intensity and magnitude. Volcanism nature extent and causes, Volcanism and climate. Avalanches causes and effects.

### **UNIT - IV**

Mineral and human use, geology of mineral resources, EIA of mineral development, Methods of extraction of mineral resources, recycling of mineral resources.

### **References**

1. Environmental geology- Edward A. Keller
2. Physical geology - C.W. Montgomery.
3. Geology of India - National book trust series.

## **16ENV22D3 Resource Management**

**M.M. : 80**  
**Time : 3 Hrs.**

**Note :** 1. Nine questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question 1 and four by selecting one from each section.

### **Unit - I**

Resource management meaning & concept, management of rangelands & watersheds, management of Agricultural system, International Biological Program, Man and Biosphere.

### **Unit - 2**

Management of waste resources, Management of forests, effects of deforestation. Management of fresh water ecosystem conservation strategies for non-renewable energy resources.

### **Unit - 3**

Wildlife Management & conservation efforts for threatened species, Water Management, Ganga Action Plan, Yamuna Action Plan, Environmental priorities in India.

### **Unit- 4**

Reclamation & Management of waste lands, soil erosion, soil conservation, rural planning & land use pattern. Sustainable development, urban planning for India, Land use policy for India.

### **References :**

1. Natural resources conservation -Oliver Ss. Owen.
2. Living of environment - T.J. Miller
3. Ecology of Natural resources - Ramade
4. Environmental Science- Cunningham Saigo
5. Restoration of degraded lands- J.S. Singh

## **16ENV22D4 Concept of Biochemistry**

Max. Marks : 80

Time : 3 Hours.

**Note:** 1. Nine questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting one from each section.

### **Unit – I**

Organisation of Biomolecules, Buffers, Principle and biological application of diffusion osmosis, viscosity and Donnan membrane equilibrium. Carbohydrates : structure and classification of carbohydrates, metabolism of carbohydrates : glycolysis, TCA cycle, HMP pathways.

### **Unit - 2**

Lipids : Classification, structure and nomenclature of lipids, Biological significance of lipids, physico- chemical properties of fatty acids and triacyl glycerol.

### **Unit - 3**

Amino acids : classification, structure and nomenclature of amino acids, physico-chemical properties of amino acids. proteins: confirmation of proteins and polypeptides secondary, tertiary and quaternary and domain structure of proteins, denaturation of proteins and Ramchandran plots.

### **Unit- 4**

IUB Classification and nomenclature of enzymes, general properties of enzymes, enzyme kinetics- Michaelis-Menten equations, Coenzymes - structure and biological function of coenzymes A, TPP, FMN, FAD, NAD and lipoic acid, structure of purine and pyrimidine bases, nucleosides and nucleotides. Primary structure of nucleic acid, Structural polymorphism of DNA and RNA, Three dimensional structure of t-RNA.

**References :** 1. Principles of Biochemistry Lehninger.





## **16ENVO1 Environmental Issues**

Max. Marks : 80

Time : 3 Hours.

**Note:** 1. Seven questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining six questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting at least one from each unit.

### **Unit-1**

Global Environmental Issues: Green House effect – causes and associated hazards, Ozone layer depletion – causes and associated hazards, Deforestation, Human Population Growth. Environmental problems associated with urbanization, industrialization, modernization of agriculture

### **Unit-2**

Regional Environmental Issues: Forest and Wildlife management, desertification, reclamation of degraded land; Human intervention on wetlands, siltation and eutrophication, reclamation of wetlands, Mining and Environment, Open cast mining, Oil exploration and transportation, Deforestation and their impact on environment.

### **Unit-3**

Pollution: Air Pollution : Causes of air pollution, Some important pollutants of air (CO, SO<sub>x</sub>, NO<sub>x</sub> and HC and Particulates) – their sources and effects on living and non-living organisms. Water Pollution: Sources of pollution of surface and ground water, Types of water pollutants. Solid Waste – Sources, characterization, disposal and management. Soil Pollution sources of soil pollution, Pollution and residual toxicity from the application of insecticides, pesticides and fertilizers; Soil erosion.

### **List of Recommended Books**

1. Fundamentals of Environmental Science: G. S. Dhaliwal, G. S. Sangha and P. K. Raina, Kalyani Publication
2. Environmental Chemistry : A. K. De
3. Environmental Chemistry : B.K. Sharma, and H. Kaur
4. Fundamentals of Ecology : E. P. Odum
5. Environmental Science (6th ed) (1997): Jr. G. T. Miller, Wadsworth Pub. Co.

## Semester-III

### 16ENV23C1 Environmental Chemistry

Max. Marks : 80

Time : 3 Hours.

**Note:** 1. Nine questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting one from each section.

#### UNIT - I

Stoichiometry, Gibb's energy, Chemical potential, Chemical equilibria, acid-base reactions. Solubility product, solubility of gases in water, the carbonate system, unsaturated and saturated hydrocarbons, Radio nuclides.

#### UNIT - II

Classification of elements, chemical speciation, Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Thermochemical and photochemical reactions in the atmosphere.

#### UNIT - III

First law of thermodynamics, enthalpy, adiabatic transformations, second law of thermodynamics, Carnot's cycle, entropy, Gibb's free energy, chemical potential, phase equilibria, Gibb's Donnan equilibrium, third law of thermodynamics, enzymes catalysis, Michaelis/ Menten equation.

#### UNIT - IV

Oxygen and ozone chemistry, Chemistry of air pollutants, Photochemical Smog, Chemistry of water, concept of D.O., B.O.D., and C.O.D, water treatment : Sedimentation, Coagulation, Filtration, tertiary and advanced treatment, redox potential. Inorganic and organic components of soil, nitrogen pathways and NPK in soils.

#### References

1. Environmental Chemistry - G.S. Sodhi
2. Environmental Chemistry - Mannhan
3. Fundamentals of soil science - Henry D. Futh
4. Textbook of limnology - G.A. Cole
5. Environmental Chemistry - Sharma and Kaur

## **16ENV23C2 Remote sensing and Geographical Information**

**M.M. : 80**  
**Time : 3 Hrs.**

**Note :** 1. Nine questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question 1 and four by selecting one from each section.

### **Unit - I**

Definition, Introduction and scope of remote sensing. Electromagnetic radiation, atmosphere window, Platforms, Sensors and type of scanning systems. Basic characteristics of sensors; salient features of sensors used in LANDSAT, SPOT and Indian remote sensing satellites.

### **Unit - 2**

Aerial photography- vantage point, cameras, Filters and types of films. Elements of visual image interpretation. Multispectral Remote sensing, Microwave Remote sensing, Photogrammetry - Introduction, Stereo- scopic vision, Projection types.

### **Unit - 3**

Digital image and image structure, Image restoration and image and image enhancement. Image classification. Remote sensing application in Forestry, Ecology and environment, Landuse, Agriculture, soils and geology, Disaster management.

### **Unit- 4**

GIS technology and its uses in environmental science, Hardware and software requirement for GIS. Conceptual model of spatial information, Conceptual model of non spatial information. GPS.

### **References :**

1. Introduction to Environmental remote sensing - Curtis
2. Principles of Remote sensing - Lily and kliffer.
3. Remote sensing of the Environment – Jenson



## **16ENV23D1 Environmental Impact Assessment**

M.M. : 80  
Time : 3 Hrs

**Note :** 1. Nine questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question 1 and four by selecting one from each section.

### **Unit - I**

Introduction to environment impact analysis, Environmental impact statement and Environmental management plan, ISO14000, EIA guidelines 1994, Notification of Govt. of India.

### **Unit - 2**

Impact assessment methodologies, Generalized approach to impact analysis. Case study: EIA of some dam, procedure for reviewing Environmental impact analysis and statement.

### **Unit - 3**

Guidelines for Environmental Audit, Baseline information and prediction (land, water, atmosphere, energy), Restoration and rehabilitation technologies, Land use policy for India.

### **Unit- 4**

Risk analysis - definition of risk, Environmental risk analysis, risk assessment and risk management, Basic steps in risk assessment - hazard identification, dose- response assessment, exposure assessment, Risk characterization.

### **References :**

1. Environmental Impact Assessment- John Glasson.
2. Methods of Environmental Impact Assessment - Morris and the rivell.
3. Environmental Impact Assessment - L. W. Canter.
4. Chemical principles of Environmental pollution - Lalloway and Ayers.
5. Industrial Environment - Assessment and strategy - S.K. Aggarwal

## 16ENV23D2 Bioremediation

M.M. : 80  
Time : 3 Hrs

**Note :** 1. Nine questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question 1 and four by selecting one from each section.

### UNIT I

Introduction, constraints and priorities of Bioremediation, Biostimulation of naturally occurring microbial activities, Bioaugmentation, *in situ*, *ex situ*, intrinsic and engineered bioremediation.

### UNIT II

Solid phase bioremediation – land farming, prepared beds, soil piles, phytoremediation, composting, bioventing and biosparging; Liquid phase bioremediation- suspended bioreactors, fixed biofilm reactors.

### UNIT III

Hazardous Waste Management; Biotechnology application to hazardous waste management – Example of biotechnology to hazardous waste management- cyanide detoxification, detoxification of oxalate, urea etc. toxic organics – phenols.

### UNIT IV

Concept of bioremediation (*in situ* & *ex situ*), bioremediation of toxic metal ions- biosorption and bioaccumulation principles, Concept of phyoremediation, Microbial leaching of ore- direct and indirect mechanism in augmentation of augmentation of petroleum recovery, Biotechnology with special reference to copper and iron.

### References

1. Environmental Biotechnology by S.K. Agarwal
2. Biodegradation % Bioremediation (1999), Martin Alexander, Academic Press.
3. Stanier R.Y., Ingram J. L., Wheelis M.L., Painter R.R., General Microbiology, McMillan Publication, 1989.
4. Foster C. F., John Ware D.A., (1987). Environmental Biotechnology, Ellis Horwood Ltd.
5. Karrely D., Chakrabarty K., Omen G.S., Biotechnology and Biodegradation, Advances in Applied Biotechnology Series, Vol . 4, Gulf Publication Co. London, 1989.
6. Bioremediation Engineering; design and application (1995) John. T. cookson, Jr. Mc Graw Hill, Inc.
7. Environmental Biotechnology by A.K. Chatterjee
8. Environmental Biotechnology by S.N. Jogdand Himalaya Publishing



## **16ENV23D3 Agriculture and Environment**

Max. Marks : 80

Time : 3 Hours.

**Note :** 1. Nine questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question 1 and four by selecting one from each section.

### **Unit - I**

Agriculture ecosystem, sustainable agriculture, organic farming and eco-friendly agroforestry, social forestry, dryland agriculture and zero tillage

### **Unit - II**

Irrigation and secondary salinization, water logging and environmental impact of multipurpose projects, Weather and crop productivity- impact of global warming in Agriculture and food security, Green, blue and white revolution.

### **Unit - III**

Pesticide classification, pesticide resistance, biology and ecology of pest control, integrated pest management, pesticide safety, Biopesticides. Biofertilizers, vermicomposting and crop residue as a source of fertilizer, Synthetic fertilizer and their impact on agriculture.

### **Unit- IV**

Biogas technology, Plant design, construction and their operation, Biofuel, Soil microorganisms and their function, Degradation of different insecticide, fungicides and weedicides in soil.

### **References :**

Sustainable Agriculture- H.R. Sharma

Global Climate Change- Pry Martin

Environmental Chemistry- Mannahan

Soils- Miller and Donhau

Environment and Agriculture- Dhaliwal, Jairath and Hansra



## **16ENV23D4 Elementary Concept of Physical Environment**

Max. Marks : 80  
Time : 3 Hours.

**Note:** 1. Nine questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting one from each section.

### **UNIT - I**

Definition, Principles and scope of Environmental Science. Earth, Man and Environment, Ecosystem, Pathways in Ecosystems, Physico-chemical and biological factors in the Environment.

### **UNIT - II**

Geographical classification and zones. Structure and composition of Biosphere. General relationship between landscapes, biomes and climates. Atmospheric instability, inversions and mixing heights, wind roses.

### **UNIT - III**

Primary differentiation and formation of core, mantle and crust. Igneous, sedimentary and metamorphic rocks, weathering, erosion, transportation and deposition of earth's material by running water, wind and glaciers.

### **UNIT - IV**

Mass and energy transfer across the various interphases, Material Balance, Heat Transfer processes, scales of Meteorology, various kinds of lapse rates, vertical stability of atmosphere, cloud classification & formation.

### **References**

1. Ecology - P.D. Sharma
2. Concepts of physical environment- Savinder Singh
3. The Atmosphere- an Introduction- F.K. Lutagens
4. Atmospheric weather and climate - Navarra.

## **16ENV23D5 Environmental Microbiology**

Max. Marks : 80

Time : 3 Hours.

**Note :** 1. Nine questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question 1 and four by selecting one from each section.

### **Unit - I**

Microbiology- organisms in nature & their importance, sampling, culture & cultivation of microorganisms, microbes in service of nature & mankind, Batch culture & continuous culture of microbes for commercial use.

### **Unit - 2**

Microbial Reactors, genetically modified microbes & their uses in Environmental management recycling & up gradation technologies, Production of products, energy from waste.

### **Unit - 3**

Biogas technology, plant design, construction, operation, biogas from organic wastes, water weeds, landfills, microbiology of anaerobic fermentation.

### **Unit - 4**

Biotransformation, bioconversion, bioremediation, phytoremediation technology, fermentation technology, development of stress tolerant plants, Environmental problems & Environmental monitoring through microorganism, microbiology of water, air and soil, microbes as pathological agent in plant, animal and man.

### **References :**

Principles of microbiology - Pelzar

Microbial bio technology - A.N. Glazer

Microbial ecology - R.M. Atlas

Molecular biology - H.D. Kumar

Environmental bio Technology - Sayler & Fox

## 16ENVO2 Disaster Management

Max. Marks : 80

Time : 3 Hours.

**Note:** 1. Seven questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining six questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting at least one from each unit.

### UNIT- I

**Disaster-** Causes and phases of disaster, Rapid onset and slow onset disasters. Nature and responses to geo-hazards, trends in climatology, meteorology and hydrology. Seismic activities. Changes in Coastal zone, coastal erosion, beach protection. Coastal erosion due to natural and manmade structures.

### UNIT- II

**Floods and Cyclones:** causes of flooding, Hazards associated with flooding. Flood forecasting. Flood management, Integrated Flood Management and Information System (IFMIS), Flood control. Water related hazards- Structure and nature of tropical cyclone, Tsunamis – causes and physical characteristics, mitigation of risks.

### UNIT- III

**Earthquakes:** Causes and characteristics of ground-motion, earthquake scales, magnitude and intensity, earthquake hazards and risks, Volcanic land forms, eruptions, early warning from satellites, risk mitigation and training, Landslides.

**Mitigation efforts:** UN draft resolution on Strengthening of Coordination of Humanitarian Emergency Assistance, International Decade for Natural Disaster Reduction (IDNDR), Policy for disaster reduction, problems of financing and insurance.

### Reference Books:

1. Bolt, B.A. Earthquakes , W. H. Freeman and Company, New York. 1988
2. Carter, N,W. Disaster Management: A Disaster Manager's Hand Book, Asian Development Bank, Manila. 1992
3. Gautam Ashutosh. Earthquake: A Natural Disaster, Ashok Publishing House, New Delhi. 1994
4. Sahni, P.and Malagola M. (Eds.).Disaster Risk Reduction in South Asia, Prentice-Hall of India, New Delhi. 2003.
5. Sharma, V.K. (Ed.). Disaster Management, IIPA, New Delhi. 1995.
6. Singh T. Disaster management Approaches and Strategies, Akansha Publishing House, New Delhi. 2006
7. Sinha, D. K. Towards Basics of Natural Disaster Reduction, Research Book Centre, New Delhi. 2006
8. Smith, K. Environmental Health, Assessing Risk and Reduction Disaster, 3rd Edition, Routledge, London. 2001 21

## **Semester-IV**

### **16ENV24C1 Environmental Laws**

Max. Marks : 80

Time : 3 Hours.

**Note:** 1. Nine questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting one from each section.

#### **UNIT - I**

Scheme of labelling of environmentally friendly products (ecomark). Public liability Insurance Act. 1991. Provision of constitution of India regarding environment (article 48 A & 58A).

#### **UNIT – II**

Environmental policy resolution, legislation, public policy strategies in pollution control. Wild life protection act, 1972 amended 2002. Forest conservation act, 1980. Indian forest act 1927.

#### **UNIT - III**

Air (prevention & control of pollution) Act 1981 as amended by amendment 1987 & rule 1982. Motor vehicle act, 1988, The environment (protection) Act, 1986, rules 1986.

#### **UNIT – IV**

The water (prevention & control of pollution) Act, 1974 as amended by amendment 1978 & rules 1975. Environment protection issues & problems, international & national efforts for environment protection.

#### **References**

1. Environmental administration & law - Paras Diwaa.
2. Environmental planning, policies & programs in India - K.D. Saxena.

## **16ENV24C2 Environmental Management and Planning**

Max. Marks : 80  
Time : 3 Hours.

**Note:** 1. Nine questions will be set in all.

2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting one from each section.

### **UNIT - I**

Role of NGO's public participation in environmental movements, Concepts of Environmental education and awareness International environmental initiatives - the Club of Rome report, Stockholm Declaration, environmental ethics.

### **UNIT - II**

Vehicular pollution and urban air quality, Fly ash utilization, Eutrophication and restoration of Indian lakes, Wet land conservation, Water crisis-conservation of water. Narmada dam, Tehri dam, Almetti dam.

### **UNIT - III**

Basic concepts of environmental planning, Environmental priorities in India, Land use planning : The land use plan (India). Soil surveys in relation to land use planning. Methods of site selection and evaluation, global imperatives, soil erosion, Formation and reclamation of Usar, alkaline and saline soil, waste lands and their reclamation, Desertification and its control.

### **UNIT - IV**

Urban planning and rural planning for India. Sustainable development- principles and practices in relation to economics and ecology. Cost-benefit analysis- its relevance. Ramsar convention on wetlands, Vienna convention and Montreal Protocol, Kyoto protocol, Earth Summit, Agenda-21.

### **References**

1. Natural Resource Conservation Owen and Chiras.
2. Environmental planning, policies and programs in India- K.D. Saxena.
3. Conservation Ecology- G.W.Cox.
4. Global Biodiversity - W.R. L. IUCN