

**SWAMI RAMANANAD MARATHWADA UNIVERSITY, NANDED**  
**CHOICE BASED CREDIT SYSTEM (CBCS)**  
**SEMESTER PATTERN**  
**Faculty of Science**  
**Post Graduate (PG) Programmes**  
**ENVIRONMENTAL SCIENCE – CURRICULUM**  
**w.e.f. Academic year 2015-16**  
**M.Sc. Environmental Science Second Year Curriculum**

**Semester-III**

<b>Paper No.</b>	<b>Name of Paper</b>	<b>External (ESE)</b>	<b>Internal (CA)</b>	<b>Total</b>
Env. 501	Applied Microbiology	Credit-3 75 Marks	Credit: 1 (25 marks) Test 15 Marks + Assignments 10 Marks	Credit- 4 100 Marks
Env. 502	Remote Sensing and G. I. S.	Credit-3 75 Marks	Credit: 1 (25 marks) Test 15 Marks + Assignments 10 Marks	Credit- 4 100 Marks
Env. 503	Biostatistics and Computational Techniques	Credit-3 75 Marks	Credit: 1 (25 marks) Test 15 Marks + Assignments 10 Marks	Credit- 4 100 Marks
Env. 504	(A) Soil Pollution and Solid Waste Management or (B) Environmental Geology and Hazards	Credit-3 75 Marks	Credit: 1 (25 marks) Test 15 Marks + Assignments 10 Marks	Credit- 4 100 Marks
Env. 505	Seminar	Credit-1 25Marks		Credit- 1
			<b>Total for Semester III</b>	<b>Credit- 17</b>
<b>Semester IV</b>				
Env. 506	Environmental Impact Assessment and Disaster management	Credit-3 75 Marks	Credit: 1 (25 marks) Test 15 Marks + Assignments 10 Marks	Credit- 4 100 Marks
Env. 507	Industrial Pollution control and Safety management	Credit-3 75 Marks	Credit: 1 (25 marks) Test 15 Marks + Assignments 10 Marks	Credit- 4 100 Marks
Env. 508	Environmental Management	Credit-3 75 Marks	Credit: 1 (25 marks) Test 15 Marks + Assignments 10 Marks	Credit- 4 100 Marks
Env. 509	(A) Energy Resource Management or (B) Industrial safety Health and Environmental management	Credit-3 75 Marks	Credit: 1 (25 marks) Test 15 Marks + Assignments 10 Marks	Credit- 4 100 Marks
Env.510	Seminar	Credit-1 25Marks		Credit- 1
			<b>Total for Semester IV</b>	<b>Credit- 17</b>
<b>Laboratory Course</b>				
Env. 511	Laboratory Course	Credit-3 75 Marks	Credit: 1 (25 marks)	Credit- 4 100 Marks
Env. 512	Laboratory Course	Credit-3 75 Marks	Credit: 1 (25 marks)	Credit- 4 100 Marks
Env. 513	Laboratory Course	Credit-3 75 Marks	Credit: 1 (25 marks)	Credit- 4 100 Marks
Env. 514	Project	Credit-3 75 Marks	Credit: 1 (25 marks)	Credit- 4 100 Marks
			Total for Laboratory Course (Annual)	Credit- 16
<b>Total for M.Sc. II Year: Sem. III + Sem. IV + Laboratory Course</b>				<b>Credit- 50</b>

# Env. 501 : Applied Microbiology

## Unit I : Introduction :

Origin of Life, Origin of Microbes, Origin of Plants and Animals, History & Scope of Microbiology, Interrelations with other fields of Microbiology, Modern Environmental Microbiology, Eukaryotes and Prokaryotes; Microbiology – Tools & Techniques: Microscopy, Bright field microscopy, Dark field Microscopy, Ultraviolet Microscopy, Fluorescence Microscopy, Phase contrast Microscopy, Electron Microscopy; Methods of staining: Monochrome, Differential, Negative, Acid fast. 10

## Unit II : Bacterial Structure & Growth :

Size, Shape, Capsules, Mesosomes, Ribosome's, Storage granules, Fimbriae, Flagella, Nucleus, Endospores; Growth: Reproduction, Growth curve, Continuous culture, Synchronous Culture, Quantative measurement of bacterial growth, Physical Conditions required for growth. 10

## Unit III : Soil microbiology :

Microorganisms in soil: Bacteria, Fungi, Protozoa, Algae, Viruses; Functions of microorganisms in soil; Humus; Functions of Humus; Role of microbes in carbon cycle; Role of microbes in Nitrogen cycle: Ammonification, Nitrification, Nitrate reduction, Denitrification, Nitrogen fixation, Symbiotic nitrogen fixation, Non symbiotic nitrogen fixation,; Role of microbes in Sulphur cycle; 10

## Unit IV : Milk and Food Microbiology :

Sources of microorganisms in Milk, Microbiological examination of Milk, Pasteurization of Milk, Dehydration of Milk, Manufactured Dairy products; Food microbiology: Initial contamination of fresh food, Microbial spoilage of foods, Preservation of foods, Microbiological examination of foods, Fermented foods, Food poisoning. 08

## Unit V : Industrial Microbiology :

General types of industrial process, Types of fermentation processes, Food and food additives, Alcoholic fermentation, Production of Vinegar, Manufacture of various chemicals, Production of microbial enzymes, Textile microbiology. 07

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## References

01. **General microbiology Volume I & II** : C. B. Powar & H. F. Dagainawala ( Himalaya publishing House, Mumbai ), 2002
02. **Fundamental principles of Bacteriology ( TMH Edition )** : A. J. Salle, ( Tata McGraw-Hill Publishing Company Limited, New Delhi ), 1974
03. **Microbiology** : P. D. Sharma ( Rastogi publication Meerut )
04. **Microbiology** : Pelizer, Reid & Chan ( Tata McGraw-Hill Publishing Company Limited, New Delhi ), 05.
- Hand book of Microbiology** : Yu. S. Krivashein ( Mir Publishers Moscow )
06. **Microbiology for Environmental Engineering** : M. C. Kinnery ( Tata McGraw-Hill Publishing Company Limited, New Delhi ),
07. **Applied Microbiology** : Vimta Kale & Kishore Bhusari ( Himalaya Publishing House, Mumbai )
08. **Soil Microbiology** : Martin Alexander, Wiley Eastern Limited, 1981
9. **Soil microbiology & Plant Growth** : N. S. Subba Rao, Oxford & IBH Publishing Co., New Delhi, 1989
10. **Food Microbiology** : W. C. Frazier, D. C. Westhoff, Tata McGraw-Hill Publishing Co., New Delhi, 1981
11. **Text Book of Microbiology** : Anantnarayan & Paniker, Orient Longman Pvt. Ltd., 2005
12. **Microbes & Man** : John Postgate, Cambridge University Press, New York, 1991

# Env. 502 : Remote sensing and Geographical Information System

## Unit I : Introduction :

Definition, Sun and Atmosphere, Concept of Signatures, Remote sensing systems, Principles of Remote sensing Why observe earth from space, Remote sensing – A Historic perspective, Indian Remote sensing Programme, 05

## Unit II : Remote sensing Sensors and Platforms :

Classification of Remote sensors, Selection of sensor parameters, Spatial resolution, Spectral resolution, Radiometric resolution, Temporal resolution; Optical infrared sensors: Quality of image in Optical systems, Imaging mode, Photographic camera, Television cameras, Opto-Mechanical Scanners, Opto-Mechanical Scanners Operated from Satellites, Pushbroom Cameras, IRS-LISS Cameras, Hyper spectral Imager, Measuring the third dimension, Image quality aspects; Microwave sensors: Antenna, Passive microwave sensors, Active microwave sensors, Side looking Radar, Scatterometer; Platforms: Principles of satellite motion, Location of satellite in space, Global Positioning Systems, Indian remote sensing Satellites. 13

## Applications of Remote Sensing :

Applications to atmospheric studies, Applications to Geographic survey, Applications to biospheric survey, Applications to Hydrospheric survey, Applications to cryospheric survey, Applications to Geo botanical exploration, Applications to Oceanography, Agricultural applications, Forest Applications, Land use mapping, Water resources, Snow and glaciers, Wetland management, Coastal zone management, Marine fisheries. 12

## Geographic Information System (GIS) :

Definition, Importance of GIS, Contributing disciplines, Major areas of applications, Development of GIS, Components of GIS, GIS diversity, GIS work flow, GIS Softwares. 10

## GIS Project designing and Management :

Problem identification, Designing a data model, Conceptual and Physical data Models, Cartographic Modeling, Project management, Implementation problems, Project evaluation 05

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## References

- 01. Fundamentals of Remote Sensing :** George Joseph, Universities Press Hyderabad, 2005
- 02. Remote Sensing and GIS :** M. Anji Reddy, BS Publications, Hyderabad, 2008
- 03. Remote Sensing Techniques in Agriculture :** D. D. Sahu, R. M. Solanki, Agrobios India, Jodhpur, 2008
- 04. GIS Basics :** Shahab Fazal, New Age International Publishers, New Delhi, 2008
- 05. Geographical Information Systems :** Anil K. Jamwal, Jnanda Prakashan, New Delhi, 2008
- 06. Environmental Science :** S. C. Santra, New Central Book Agency, Kolkata, 2005
- 07. A Text Book of Environmental Science :** Purohit, Shammi, Agrawal, Student Edition, Jodhpur, 2004
- 08. Environmental Science Principles and Practices :** R. C. Das, D. K. Behra, Printice Hall, New Delhi, 2008

## Env. 503 : Biostatistics and Computational Techniques

### Unit I : Introduction to Biostatistics :

Definition, Development of Biostatistics, Application of Biostatistics, Role of Biostatistics, Some definitions concerning statistics inference, Characteristic of statistics, Limitations of statistics, Data: Classification of Data; Collection of Data: Collection of primary data, Collection of Secondary data; Diagrammatic presentation of Data: Simple bar diagram, Multiple bar diagram, Pie diagram; Graphical presentation of data: Histogram, Frequency polygon, Frequency curve, Ogive curve. 10

### Unit II : Measures of Central tendency :

Characteristics of a good average, Calculation of Arithmetic mean, Merits of mean, Demerits of mean, Calculation of Median, Merits of median, Demerits of median, Calculation of Mode, Merits of mode, Demerits of mode, 10

### Unit III : Measures of Dispersion and Correlation Analysis:

Definition, Objects of measuring dispersion, Properties of good measure of dispersion, Calculation of standard deviation, Merits and Demerits of standard deviation; Correlation Analysis: Definition, Uses, Types of correlation, Methods of studying correlation, Merits and Demerits of Correlation; Probability: Basic concepts, Measures of probability, Thermos of probability; Chi-square test: Characteristics of  $X^2$  test, application of  $X^2$  test. 12

### Unit IV : Introduction to Computers :

Uses of computers, Components of computer, Types of computers; DOS: Working of DOS, DOS prompt, DOS Commands; Windows; Ms-Word; MS Excel 10

### Unit V : Internet and E - mail :

Internet connection, Website, Internet Browsing, Applications of Internet, E-mail 03

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## References

01. **Biostatistics** : P. N. Arora, P. K. Malhan, Himalaya publishing House, Delhi, 2008
02. **Basic concepts of Biostatistics** : N. Arumugam, Saras Publications, Kanyakumari, 2003 03.
- Biostatistics in theory and Practice** : T. K. Saha, Emkay Publications, Delhi, 1992
04. **Biostatistics** : P. Ramakrishnan, Saras Publications, Kanyakumari, 1995
05. **Environmental Science** : S. C. Santra, New Central Book Agency, Kolkata, 2005 06.
- Statistical Methods** : S. C. Gupta, S. Chand & Sons Publishers, New Delhi, 1997
07. **Evolution Biostatistics & Computer Applications** : A. Gopi, A. Meena, N. Arumugam, Saras Publications, Kanyakumari, 2003
08. **Fundamentals of Computer** : V. Rajaraman, Prentice Hall of India, New Delhi, 2008
9. **Computer Fundamentals** : Pradeep K. sinha, Preeti Sinha, BPB Publications, New Delhi, 2007
10. **Computer** : Malhar V. Lathkar, Sadhusudha Prakashan, Nanded, 1995
11. **Environmental Science Principles and Practices** : R. C. Das, D. K. Behra, Printice Hall, New Delhi, 2008

# Env. 504 (A) : Soil Pollution & Solid Waste Management

## Unit I : Introduction :

Importance of soil, Salt affected soils, Reclamation, Acid soil indicator plants, Alkaline soil indicator plants, Saline soil indicators, Solid waste pollution scenario in India. 04

## Unit II : Sources and detrimental effects of soil pollution :

Sources of soil pollution: Industrial wastes, Urban wastes, Radioactive wastes, Agricultural practices, Chemical and metallic pollutants, Biological agents; Absorption of toxic metals by soil; Chemicals absorbed in the soil, Cadmium accumulation in soil, Animal manures added to soil, Waste water added to soil, Solid waste applied to soil, Salt stress in soil; Detrimental effects of soil pollution : Effects of Industrial pollutants, Effects of urban waste products, Effects of radioactive pollutants, Effects of modern agro technology, Effects of pesticides, 14

## Unit III : monitoring, Analysis of soil pollutants and soil pollution control :

Monitoring and Analysis of Pesticides, Herbicides, Fungicides, Carcinogens, Industrial pollutants; Remedial measures for soil pollution, Methods to minimize soil pollution, Bacterial fertilizer, Fungi to increase soil fertility. 06

## Unit IV : Solid waste :

Sources and characteristics; Solid waste properties : Chemical composition, Density characteristics, Combustion properties, Reuse characteristics; Types of solid wastes: Residential wastes, Commercial wastes, Industrial wastes, Demolition wastes, Bulky wastes, Hazardous wastes, Biomedical Wastes; Collection and transportation of solid wastes: Storage, Containers, Bags, Drop boxes, Compactors, Source segregation and reclamation, Collection system parameters, Types of services, Collection equipments, Solid waste processing, Long distance transport; Disposal of solid wastes: Hog feeding, open dumping, Sanitary landfills, Pyrolysis, Incineration, Controlled tipping, Pulverization, Hammer mills, rotating drum Machines. 16

## Unit V : Solid waste management :

Utilization, Recovery, Reuse, Recycling of waste and residues, avoidance of solid wastes, Packaging. 05

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## References

01. **Soil and Noise Pollution** : B. K. Sharma, H. Kaur, Goel Publishing House, Meerut, 1994
02. **Solid waste pollution** : Dr. Aradhana Salpekar, Jnanada Prakashan, New Delhi, 2008.
03. **Principals of soil science** : M. M. Rai
04. **Soil pollution & Soil organisms** : P. C. Mishra 05.
05. **Environmental Chemistry** : B. K. Sharma
06. **Environmental Science** : S. C. santra, New Central Book Agency, Kolkata, 2005
07. **Environmental Pollution Control Engineering**, C. S. Rao, New age International, Mumbai, 2003 .
08. **Fundamentals of Soil Science** : Henry D. Foth, John Wiley & Sons, New York, 1984
09. **Environmental Engineering** : Davis & Cornwell, McGraw – Hill Publications, New York, 1998
10. **Environmental Science Principles and Practices** : R. C. Das, D. K. Behra, Printice Hall, New Delhi, 2008

## **Env. 504 (B) : Environmental Geology and Hazards**

### **Unit I**

Introduction: Origin and evolution of the earth; Plate tectonics – Sea floor spreading and continental drift, mountain building Earth's Surface Processes Transportation and deposition of earth's materials by running water, wind and glaciers; Development of landforms. 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 07

### **Unit II**

Environmental hazards: Definition - Hazard, vulnerability and risk; Natural and man-made hazards, Earthquake and Volcanic Hazards: Origin and severity of earthquakes, effects of earthquakes, risk evaluation, seismic hazards and its zonation in India with special reference to North East India, Coping with seismic hazards Origin and types of volcanic activities; Volcanic belts; Nature of volcanic hazards, mitigation of volcanic hazard vulnerability. 07

### **Unit III**

Flood hazard and its management: Definition - Floods, Floodplains and Flood-Prone Areas; Causes, nature and frequency of flooding; urbanization and flooding; Flood Hazard Assessment - environmental effects of flooding, Flood prone areas of India and associated hazards, flood mitigation and management in Northeast India. 08

### **Unit IV**

Slope instability and Landslide hazard: Causes - destabilizing forces; mass movement types; human use and landslides; Identification of landslide zones and their control, strength of materials and instability of slopes, subsidence and swelling of ground. 06

### **Unit V**

Desertification and Drought – Causes of desertification; Evaluation of desertification hazard – potential and zoning: Drought - causes, types, distribution and management. Man-made Hazards: Hazards due to dams and reservoirs, hazards due to nuclear power plant, Industrial hazards, Occupational hazards, Mitigation measures.

Strategies for mitigation – warning system, forecasting, Emergency Preparedness, Education and Training Activities, planning for Rescue and Relief works. 07

### **References:**

1. Natural Hazards – Local, National, Global: G. F. White (ed), Oxford University Press
2. Environmental geology- Edward A. Keller
3. Physical geology - C.W. Montgomery.
- 4 Geology of India - National book trust series.
- 5 Boundary layer climates ( 1978): T. R. Oke; Methuen & Co. Ltd.
6. Introduction to Micrometeorology (1988): S. Pal Arya; Academic Press.
7. Earths Dynamic Systems (8th ed): Hamblin: Prentice Hall.

## Semester-IV

### Env. 506 : Environmental Impact assessment & Disaster Management

#### Unit I : Introduction :

Definition, Methods of Environmental Impact Assessment : Adhoc method, Overlay method, checklist and Matrices method, 1) Initial Screening 2) Rapid Environmental Impact assessment 3) Comprehensive Environmental Impact Assessment, Developmental activities requiring EIA, Cost Benefit Analysis, Relationship between cost of damage and cost of control, EIA in India, Nexus between Development and Environment , Role of EIA in Society, Status of EIA in India, Statutory requirements for EIA, Micro-environmental problems immediately affecting lives of citizens, Macro environmental problems. (08)

#### Unit II : Process of EIA :

EIA and quality of life, EIA procedures, Environmental Impact Statement ( EIS ), Peoples participation in EIA process, Characteristics of Good EIS, Design of EIA studies , Structure of EIA report, Review of methodologies of EIA ; Checklists methods for EIA Study.

#### Unit III : Legislations and Case studies:

Important matter for consideration in carrying out EIA for energy, Policy and Programme. Impact Identification network, Strategies for environmental management plan and green belt development, Environmental appraisal of projects with respect to industry, mining and water resources, Critical issues and formulation of strategies for EMP, Strategic environmental Impact Assessment methods and benefits. Legislation of EIA in India. Case studies.: Thermal power plants, mining projects, tourism and coastal zone development and river valley projects. (10)

#### Unit IV : Environmental audit :

A support tool for environmental management systems, Definition, Concept of EA, Type of EA, Benefits of EA, Audit Methodology, Pre audit , on site audit and post audit activities, water audit, raw materials audit and energy audit, Health and Safety audit, Environmental Audit Scenario in India, EA as a management tool, Environmental management systems (EMS), Concept of ISO 9000 and ISO 14000 in ESM, Environmental labeling, Eco –Labeling, Indian Scenario. (07)

#### Unit V : Natural Disasters :

Natural Disasters- Floods, landslides, earthquake, volcanism, avalanche, cyclones, drought and fire, Tsunami, Wind storms, . Prediction, perception and adjustment to hazards. Disaster Management- Natural Hazard Management, Environmental risks due to project activities, Preparation of on site and off site disaster management plans. Pre disaster, actual disaster, post disaster, relief camp organization, Role of voluntary organization and armed forces. (12)

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### References

01. **Environmental Impact Assessment** : Principles and Procedures, John Wiley and Sons, New York.
02. **Environmental Impact Assessment** : A.K.Shrivastav, APH Publishing Corporation, New Delhi.
03. **Environmental Impact Assessment** : S.A.Abbasi, D.S.Arya, Discovery Publishing House, New Delhi.
04. **Environmental Pollution Control** : Neelima Rajvidya and Dilipkumar Markandey, APH Publishing Corporation, New Delhi. (2005)
05. **Environment Problems and Solutions** : D.K.Asthana and Meera Asthana, S.Chand & Co. Ltd. New Delhi.
06. **Introduction to Environmental Management** : Dr.Anand S.Bal, Himalaya Publishing House, New Delhi.
07. **Environmental Impact Analysis Handbook** : John G.R. and David C.Wooten, McGraw Hill Publications. (1987)
08. **Encyclopedia of Ecology and Environment** : Environmental Impact Assessment Vol. 7 : By Trivedi P.R., Indian Institute of Ecology and Environment, New Delhi (1999)
09. **Natural Disaster Reduction** : Girish K.M. and G.C.Mathur, Reliance Publishing House, New Delhi. (1993)
10. **Disaster Management** : Shailendra K.Singh , Subhash. C, Kundu and Shobhue Singh , Mittal Publications, New Delhi. (1998)
11. **Disaster Preparedness in India** : Narendra Kumar Jain, Adhyatma Sadhana Kendra, New Delhi. ( 1996)
12. **Disaster Management** : Dr. S. R. Singh, A. P. H. Publishing Corporation, New Delhi, (2008)
13. **Environmental Science** : S. C. Santra, New Central Book Agency, Kolkata, 2005

## Env. 507 : Industrial Pollution Control & Safety Management

### Unit I : Introduction :

Environmental Guidelines for industry, Water for industry, Hard and soft water, Fuels, Devices for power generation, Refrigeration and air conditioning, Carbonization of coal, Liquid fuels from coal, Fuel gases;  
Industrial gases: Hydrogen, Oxygen and Nitrogen, Carbon di oxide, Acetylene, Ethylene 05

### Unit II : Organic chemical Industries :

Manufacturing, Water pollution, Air pollution and Control measures from Fertilizer industries, Synthetic Fiber industry, Electroplating industry, Petrochemical industry, Paint and pigment industry, Insecticide industry, Drugs industry, Dyes industry, Polymer industry. 08

### Unit III : Inorganic Chemical Industries :

Manufacturing, Water pollution, Air pollution and Control measures from Ceramic industry, Plastic industries, Sodium salt industry, Glass industry, Tanning industry, Alkali and chlorine industry. 08

### Unit IV : Agro based industries :

Manufacturing, Water pollution, Air pollution and Control measures from Oil industry, Cellulose and pulp industry, Paper industry, Rubber industry, Sugar and starch industry, Alcohol industry, Textile industry.08

### Unit V : Industrial Safety management :

Safety Management, Objectives of Safety management, National safety Council, Safety acts and Provisions for workers welfare, Principles of Safety management, Safety Organization, Management's safety policy, Responsibilities of Management for safety in plant,; Safety and housekeeping; Industrial fire management: Fundamentals of fire, Elements of fire, Classification of fires, Common causes of industrial fires, Fire-Extinguishing Techniques, Fire-Extinguishing agents and applications, Fire protection & Fire fighting. 16

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## References

1. **Industrial Chemistry** : B. N. Chakrabarty, Oxford and IBH Publishing Co., New Delhi, 1998
2. **Environmental Science** : S. C. Santra, New Central Book Agency, Kolkata, 2005
3. **Industrial Chemistry** : B. K. Sharma, Goel Publishing House, Meerut, 1994
4. **Industrial Chemistry** : Harish Kumar, Sarup & Sons Publishers, New Delhi, 2000
5. **Pollution management in Industries** : R. K. Trivedy, Environmental Publications, Karad, 1995
6. **Industrial water pollution control** : W. Wesley Eckenfelder Jr., McGraw-Hill Book Company, New Delhi, 1989
7. **Environmental Science** : S. C. Santra, New Central Book Agency, Kolkata, 2005
8. **Industrial Hygiene** : Dr. G. R. Kakri, Everest Publishing House, Pune, 1987
9. **Reutilization of Industrial Effluents & Wastes** : R. K. Baslara, A. K. Shrivastava, Pragati Prakashan, Meerut, 2008
10. **Waste Water Treatment** : Rao & Datta A. K.
11. **Waste Water Treatment** : S. P. Mahajan
12. **Environmental Management** : G. N. Pandey, Vikas Publishing House, Noida, 2007.
13. **Water pollution** : V. P. Kudesia, Pragati Prakashan Meerut, 2007
14. **Industrial Safety, Health & Environment Management Systems** : R. K. Jain, Sunil S. rao, Khanna Publishers, Delhi, 2007
15. **Reutilization of Industrial Effluents and Wastes** : R. K. Baslass, A. K. Srivastava, Pragati Prakashan, Meerut, 2008



# Env. 508 : Environmental Management

## Unit I : Introduction to Environmental Management:

Need for Environmental Management, Concept of Environmental management, Objectives and Components. Fertilizer Management :Chemical and Bio-fertilizers; Pest Management : Chemical, Biological, Integrated Pest Management; Integrated Forest Management : Deforestation, Afforestation, and their effects; Wildlife Management and Protection; Waste management : Disposal of Solid and Liquid Wastes, Recycling and Reuse; Problems with specific reference to Hazardous waste; Pollution abatement strategies : A basis for Preventive Environmental Policy (PEP). 15

## Unit II : Environmental Policies :

Global Environmental Policies and National Strategies for Protection of Environmental Quality 1) Introduction, International Policies. 2) The Agenda 21 of Earth Summit. 3) Major International Organizations and Agencies Involved in Environmental Management. 4) Environmental Protection Efforts at National Level. 5) National Environmental Policy, Constitutional Mandate. 08

## Unit III : Modeling in Environmental Science :

Mathematical models, Limitations of model application, Box model approach, Prey predator model, Models in Fisheries, Forest model, Ecosystem model. 05

## Unit IV : Environmental Legislation :

Basic Concepts; Criminal versus Civil Liability; Doctrine of strict liability; History of Environmental Legislation in India; Lacunae in Environmental Acts and Policy, Scope for improvement; National Environmental Appellate Authority; Environmental Tribunal; Green benches; Role of Central Pollution Control Board and State Pollution Control Boards. 10

## Unit V : Laws of Environmental Protection :

The Water Act (1974); The Air Act (1981); Environmental Protection Act (1986); Convention of Biodiversity act (1992); Salient Features of Wild Life Protection Act (1972); CRZ Notification; Salient features of Forest Act (1927) and Forest Conservation Act ,1980. 07

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## References

01. **Environmental Law and Policy in India** : Divan S and Rosencraz A,Oxford University Press, New Delhi. (2001)
02. **Environmental Laws of India - An Introduction** : CPR Environmental Education Centre, Chennai (2001).
03. **Conservation and Environmentalism - An Encyclopedia** : Paehlka R. Garland Publishing Inc. New York. (1995)
04. **Environmental Awareness and Education** : V.P.Kudesia, Educational Publishers, Meerut U.P. 05.
05. **Biodiversity** : V.P.Kudesia, Educational Publishers,Meerut,UP.
06. **Our Environment and Green Revolution** : M.P.Mishra, S.Chand & Co.Ltd.New Delhi.(2000)
07. **Environmental Concerns and Strategies** : T.N.Khoshoo.
08. **Environmental Management in India** : R.K.Sapru.
09. **Environmental Ecology** : Gurudeep Raj, P.R.Trivedi, Akashdeep Publishing House, New Delhi.
10. **Forests in India** : V. P. Agrawal, Oxford & IBH Publishing Co. Pvt.Ltd. New Delhi, (1968).
11. **Introduction to Social Forestry** : Sitram Rao, Oxford and IBH Pub. Co. Pvt. Ltd.
12. **An Introduction to Environmental Management** : Dr. Anand S. Bal, Himalaya Publishing House (2005).
13. **Environmental Pollution – Management & Control for Sustainable Development** : R. K. Hitoliya, S.Chand and Co.Ltd.New Delhi (2004).
14. **Environmental Science** : S. C. Santra, New Central Book Agency, Kolkata, 2005

## Env. 509 (A) : Energy Resource Management

### Unit I : Energy :

Different forms of energy; Sources of Energy: Non renewable energy, Renewable energy 02

### Unit II : Renewable Energy :

Alternate sources of energy; Solar energy: Solar thermal energy, Solar electricity generation, Solar heaters, Solar dryers, Solar cookers, Solar desalination, Solar photovoltaic energy, Crystalline solar cells; Wind energy: Energy from wind, History of Wind mills, Wind Power plants, Wind power potential in India; Geothermal energy: Sources of geothermal energy, exploitable geothermal reserves, power generation from geothermal energy, Advantages of geothermal energy; Hydroelectric energy: micro hydropower, Hydropower and the environment; Tidal and wave energy: Ocean Thermal Energy Conservation, Tidal energy, Wave energy. 16

### Unit III : Non Renewable Energy Resources :

Petroleum: Extraction of crude oil, History of petroleum production, Environmental effects; Coal: Origin of coal, Composition of coal, Types of coal, Uses of Coal, Coal and the Environment; Gas: Formation, Sources of natural gas, Natural gas and the Environment; Nuclear energy: Nuclear fission, Theory of nuclear fission, Energy released in nuclear fission; Nuclear fuel Uranium, Nuclear power and the Environment. 16

### Unit IV : Biological Energy :

Bio Fuel: Classes of bio fuel, Sources of bio fuel, Production of bio fuel, Types of high volume industrial biomass on earth, Ethanol. Biodiesel : Introduction, Plant oils used for bio diesel; Production of bio diesel: Vegetable oils as diesel fuels, Manufacturing process for bio diesel, Industrial scale production of bio diesel. 07

### Unit V : Biomass energy :

Biomass energy: Wood and wood waste, Municipal solid waste, Landfill gas, Biomass and the Environment. 04

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### References

01. **Ecoinformatics Volume 5** : S. K. Agarwal, A. P. H. Publishing Corporation, New Delhi, 2002.
02. **Fuels and Biofuels** : Vijayalaxmi, Meena Devi, Nagendra Prasad, Agrobios (India), Jodhpur, 2007.
03. **Environmental resource Conservation** : S. K. Shukla, P. R. Shrivastava, Commonwealth Publishers, New Delhi, 1992.
04. **Environmental Science** : S. C. Santra, New Central Book Agency, Kolkata, 2005
05. **Environmental Problems & Solutions** : D. K. Asthana & Meera Asthana, S. Chand & Co. New Delhi, 1998
06. **Environmental Science** : Eldon D. Enger, J. Richard Kormelink, B. F. Smith, R. J. Smith, WMC Brown Co. Dubuque, Iowa, 1984
07. **Environmental Science** : Bernard J. Neble, Richard T. Wright, Prentice Hall, New Jersey, USA, 1981
08. **Non Conventional Energy Sources** : S. N. Kaul, A. R. Bhalerao, R. K. Trivedy, Current Publications, Agra, 2007
09. **Fundamentals of Environmental Science** : G. S. Dahliwal, G. S. Sangha, P. K. rathan, Kalyani Publishers, New Delhi
10. **Environmental Science** : Enger Smith, Smith, W. M. C. Brown ( Company Publishing )
11. **Environmental Chemistry** : B. K. Sharma & H. Kaur( Goel Publishing House, Meerut )

## **Env. 509 (B) : Industrial Safety, Health and Environmental Management**

### **Unit I**

Introduction Perspectives and concerns, Interrelationship and interactive approach between safety, health & environment. Fundamentals to industrial safety management and its significance, Hazard identification, assessment and control techniques, Industrial hygiene and health. Safety and Health Hazards Identification of potential safety Occupational Health Role of government organizations for occupational health Factories Act ISO 18000. 07

### **Unit II**

Health and Safety Risk Management Risk identification, Allocation and mitigation strategies Risk assessment Risk Management. Role of organizations WHO and other bodies and their role in public health project development, eradication programs and their efficacy, development impacts in urban and rural sectors, psychological impacts, Role of NGOs. 05

### **Unit III**

Major environmental movements in India: Chipko Movement, Narmada Dam, Tehri Dam, Almetti Dam, Reclamation of alkaline and saline soil. Role of UN authorities in protection of Global Environment. Environmental laws in India: Legal, administrative and constitutional provisions for environmental protection in India; Statutory protection of the Human Environment - Factories Act, Motor Vehicle Act, Hazardous Waste legislation for pollution abatement; Anti Pollution Acts - The water Act. 1974. The Air Act 1981. The Environment Protection Act, 1986 . 10

### **Unit IV**

Environmental Management: Concept and scope, Systems and approaches, Standards - international and national; Ecomark; Environmental accounts and auditing, Green funding and taxes, Trade and environmental management.05

### **Unit V**

Ecosystem Management: Ecosystem analysis, modeling, monitoring and planning; Ecotourism and heritage management; Eco-restoration Environmental management of water, forest and biological resource. 08

### **Reference Books:**

- 1.Sustainable development (Vol. I & II): N. L. Gupta and K. K. Gurjar (ed); Rawat Publications
- 2.Environmental management: G. N. Pandey; Vikash Publishing House
- 3.Environmental management: H. M. Saxena; Rawat Publications
- 4.Environmental Law and Policy in India: S. Divan & A. Rosencranz; Oxford University Press
- 5.Environmental Management – Physio-ecological facets (Vol. I & II): Rai, Mohapatra & Goel (ed); Rawat Publications.
- 6.Chemical Process Safety, Crowl , Louvar, (2nd Edi), PHI
- 7.Handbook of environmental Health and Safty, Herman Koren, Michel Bisesi, 1999, Lewis Publiser
- 8.Environmental Risk Analysis, Ian Larche, Paleologes, 2001, Mc Graw Hill
- 9.Safety at work, John Ridley, Butterworth Heinemann
- 10.Handbook of hygiene and public health, Yashpal Bedi, (2nd Edi.)Anand Publishing Co.
- 11.Environmental Toxicology, M Satake, Y Mido, M.S Sethi, Discovery Publishing house

## Env. 511 : Laboratory Course

1. Study of Bacteria ( Types ).
2. Isolation of bacteria from Air.
3. Isolation of Fungi from Air.
4. Observation of motility of organisms by hanging drop technique.
5. Monochrome staining.
6. Differential ( Gram's ) staining.
7. Negative staining.
8. Endospores staining
9. Isolation of bacteria by Streak plate, Pour plate, Spread plate method.
10. Total Viable Count of Water.
11. Determination of Total Coliforms from water.
12. Determination of Fecal Coliforms from water.
13. Differentiation between Fecal and non fecal Coliforms by IMViC test.
14. Determination of Quality of Milk by Methylene Blue Reductase test.
15. Qualitative test for protein by biuret test.
16. Qualitative test for carbohydrate by Benedict's test.
17. To Study the Effect of Temperature on bacterial Growth.
18. To Study the Effect of  $P^H$  on bacterial Growth.
19. Determination of Growth curve of Bacteria.
20. Study of effectiveness of Hand washing.

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## References

01. **Practical Methods in Ecology and Environmental Science** : R. K. Trivedy, P. K. Goel, Trisal ( Environmental Publication, Karad )
02. **Manual of Environmental Pollution Analysis** : N. N. Bandela, Masarat Sultana, Uday P. Patil ( Prathivi Publication, Aurangabad )
03. **A Manual of Fresh water ecology** : R. Santhanam, P. Velayutham, G. Jegatheesan ( Daya Publishing House, Delhi )
04. **Physico-Chemical Examination of Water, Sewage & Industrial effluents** : N. Manivasakam ( Pragati Prakashan, Meerut )
05. **Manual on Water and Waste Water Analysis** : National Environmental Engineering Research Institute, Nagpur
06. **Methodology for Water Analysis** : Dr. Mohan S. Kodarkar, ( Indian Association of aquatic Biologist's, Hyderabad )
07. **Chemical and Biological methods for Water Pollution Studies** : R. K. Trivedy, P. K. Goel ( Environmental Publication, Karad )
08. **Methods in Environmental Analysis : Water, Soil, Air** : P. K. gupta, ( Agrobios India, Jodhpur )
9. **Chemical methods for Environmental analysis: Water & Sediments** : R. Ramesh & M. Anbu ( Macmillan India Limited )
10. **Microbial Analysis** : Aneja,
11. **Practical Microbiology** : R. C. Dubey, D. K. maheshwari, S. Chand & Co., New Delhi, 2008.

## Env. 512 : Laboratory Course

### Statistical Problems

1. Mean.
2. Median.
3. Mode.
4. Standard Deviation.
5. Correlation Analysis.
6. Probability.
7. Chi-Square Test.
8. Computer Problems.

### Soil Pollution

1. Determination of Bulk density of soil.
2. Determination of Water holding capacity of soil.
3. Determination of Specific gravity of soil.
4. Determination of Soil  $P^H$
5. Determination of Soil Conductivity.
6. Determination of Sulphate from Soil by Turbidimetric Method.
7. Determination of Nitrate from Soil by Spectrophotometric Method.
8. Determination of Phosphates from Soil by Spectrophotometric Method.
9. Determination of Sodium from Soil.
10. Determination of Potassium from Soil.
11. Isolation of Azatobacter from Soil.
12. Isolation of Sulphur bacteria from Soil.

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### References

01. **Biostatistics** : P. N. Arora, P. K. Malhan, Himalaya publishing House, Delhi, 2008
02. **Basic concepts of Biostatistics** : N. Arumugam, Saras Publications, Kanyakumari, 2003
03. **Biostatistics in theory and Practice** : T. K. Saha, Emkay Publications, Delhi, 1992
04. **Biostatistics** : P. Ramakrishnan, Saras Publications, Kanyakumari, 1995
05. **Environmental Science** : S. C. Santra, New Central Book Agency, Kolkata, 2005
06. **Statistical Methods** : S. C. Gupta, S. Chand & Sons Publishers, New Delhi, 1997
07. **Environmental Analysis Water, Soil & Air** : M. M. saxena, Agro Botanical Publisher, Bikaner, 1987
08. **Practical Methods in Ecology and Environmental Science** : R. K. Trivedy, P. K. Goel, Trisal ( Environmental Publication, Karad )
09. **Manual of Environmental Pollution Analysis** : N. N. Bandela, Masarat Sultana, Uday P. Patil ( Prathivi Publication, Aurangabad )
10. **Methods in Environmental Analysis : Water, Soil, Air** : P. K. gupta, ( Agrobios India, Jodhpur )

## Env. 513 : Laboratory Course

- 1) Preparation of Air quality Impact Assessment check list.
- 2) Preparation of Environmental Health Impact Assessment Checklist.
- 3) Preparation of Noise Impact Assessment Checklist.
- 4) Preparation of Water Quality Impact Assessment Checklist.
- 5) EIA Case study : Thermal power plants.
- 6) EIA Case study : River valley projects.
- 7) EIA Case study : Any one Industry.
- 8) Preparation of Environmental Audit Report.
- 9) Determination of Nitrogen from soil by Kjeldhal Method.
- 10) Determination of Calcium from soil.
- 11) Determination of Magnesium from soil.
- 12) Analysis of Effluents from Textile Industry By TLC Method.
- 13) Analysis of Effluents from Pharmaceutical Industry By TLC Method.
- 14) Analysis of Effluents from Metal Industry By TLC Method.
- 15) Estimation of BOD from Industrial effluents.
- 16) Estimation of COD from Industrial effluents.
- 17) Study of Relative Stability of Organic Effluents.
- 18) Determination of Sulphite from Effluents of Pulp & paper Industry.
- 19) Types of fire extinguishers used in Industrial safety
- 20) Use of personal protective equipments in industrial safety  
(Rubber Gloze, Leather Gloze, Helmet, Safety shoes, Welding apron, breathing apparatus etc.)

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### References

01. **Practical Methods in Ecology and Environmental Science** : R. K. Trivedy, P. K. Goel, Trisal ( Environmental Publication, Karad )
02. **Manual of Environmental Pollution Analysis** : N. N. Bandela, Masarat Sultana, Uday P. Patil ( Prathivi Publication, Aurangabad )
03. **A Manual of Fresh water ecology** : R. Santhanam, P. Velayutham, G. Jegatheesan ( Daya Publishing House, Delhi )
04. **Physico-Chemical Examination of Water, Sewage & Industrial effluents** : N. Manivasakam ( Pragati Prakashan, Meerut )
05. **Manual on Water and Waste Water Analysis** : National Environmental Engineering Research Institute, Nagpur
06. **Methodology for Water Analysis** : Dr. Mohan S. Kodarkar, ( Indian Association of aquatic Biologist's, Hyderabad )
07. **Chemical and Biological methods for Water Pollution Studies** : R. K. Trivedy, P. K. Goel ( Environmental Publication, Karad )
08. **Methods in Environmental Analysis : Water, Soil, Air** : P. K. gupta, ( Agrobios India, Jodhpur )
09. **Chemical methods for Environmental analysis: Water & Sediments** : R. Ramesh & M. Anbu (Macmillan India Limited)

## Env. 514 : Project

Project should be completed in the fourth semester and the report of project should be submitted to the concerned department of the College one month before the practical examination of fourth semester.

The presentation of Project work is compulsory to every student. The presentation of project should be done at the time of practical examination.