

॥ अंतरी पेटवू ज्ञानज्योत ॥

**NORTH MAHARASHTRA UNIVERSITY,  
JALGAON**



**Syllabus For M.Sc.-I<sup>st</sup> Year  
(Sem.-I & II)**

**ENVIRONMENTAL SCIENCES.**

**(With effect from June, 2004)**

**NORTH MAHARASHTRA UNIVERSITY, JALGAON.**

**SYLLABUS FOR M.Sc.-I<sup>st</sup> Year (Sem.-I & II)**

**ENVIRONMENTAL SCIENCES.**

W.E.From June, 2004

N.M.U., Jalgaon

**SEMESTER-I**

**EES - 101: Environmental Sciences: An Interdisciplinary Approach**

**EES - 102: Ecology and Environment**

**EES - 103: Environmental Chemistry**

**EES - 104: Practical Course on Environmental Chemistry**

**EES - 105: Practical Course on Eco-system**

**EES-101: Environmental Sciences: An Interdisciplinary Approach**

**Basic issues in environmental sciences:**

Definition, principles and scope of environmental science, human population growth, urbanization, sustainability and carrying capacity, environmental attitudes of individuals, society, corporate bodies and global institutions (07)

**Earth as a system:**

Environmental unity, earth and life, earth as a eco-system, changes and equilibrium in systems, mass and energy transfer across various interfaces, material balance, first and second law of thermodynamics, heat transfer process. (08)

**Environmental geo-science and geo-chemistry:**

Basic environmental problems, geo-science factors in environmental planning, Environmental geo-science-fundamental concepts (i) short term geological hazards- floods, landslides, earthquakes, volcanoes (ii) Long term hazards-erosion, desertification, urbanization.

Concept of major trace elements and REE classification of trace elements, mobility of trace elements, biogeochemical factors in environmental health. (08)

**Urban environment, waste management and sustaining living resources :**

City as a system, influence of city life on city planning and environment, concept of waste disposal.

Food and resources supply and environment, ecological perspective on agriculture forestry, sources of food, soil and agriculture.

(10)

**Effects of agriculture on environment:**

Effects of fertilizers on agriculture, pest control and agro-chemicals, integrated pest management, undesirable effects of irrigation.

(08)

**Minerals, environment and environmental economics :**

Importance of minerals in environment, agriculture, industry and life, resources and reserves, procurement methods and disposal. Importance of environmental economics, use of desirable resources vis-a-vis sustainability, minimization of pollution, cost benefit analysis (CBA), policy instruments.

(07)

**Recommended Books:**

- i) Environmental Sciences, Daniel Botkin and Edward Keller, John Wiley and Sons, New York (1997).
- ii) Environmental Science, Eldon D. Enger and Bradley F. Smith, WCB Publishers, Boston (1995).
- iii) Forests in India, Dr. A. K. Jain Vorha Publication, Allahabad (1989).
- iv) Advances of Environmental Science and Technology, Nileema Rajvaidya APH Publishing House, Delhi (1989)
- v) T.D. Bishwas & S. K. Mukharji, A.J.B. of Soil Sciences, Tata Mc-graw hill pub. Co. Ltd. New Delhi. (II Edition 1997)

**EES-102: Environment and Ecology**

**Introduction to ecology:**

Scope, basic concepts in ecology, levels of ecology, environmental heterogeneity, dynamism and evaluation of environment, reducing and oxidizing atmosphere, autecology and synecology and applied ecology, environmental complexes, interaction of ecological factors.

(07)

**Abiotic factors:**

Light, temperature, precipitation (rainfall), humidity. Atmosphere – gases and wind, atmospheric gases, wind factor and fire factor-

- (i) Topographic factor (Physiographic) – height and direction of mountain steepness of slopes and exposure of slopes.
- (ii) Edaphic factor – Importance, formation of soil, factors affecting on soil formation, soil composition, soil profile, soil erosion and soil conservation.
- (iii) Ecological Adaptations – Ecological groups of plants and ecological adaptations (i) Hydrophytes (ii) Mesophytes (iii) Xerophytes (iv) Halophytes.  
Ecological adaptations in animals. (12)

**Biotic factors:**

- (i) Population ecology – Population characteristics, population growth curves, law of population growth, biotic potential, natality, mortality, age structure.
- (ii) Ecosystem-Introduction, kinds of ecosystem, structure and function of ecosystem, ecological energetics, energy flow in ecosystem, energy flow models, food chain and food webs, pyramids of energy, biomass and numbers.  
Major ecosystems – pond, grassland, forest, desert, cropland etc. productivity of different ecosystems- primary productivity in terrestrial ecosystems, secondary productivity. Biogeochemical cycles in ecosystems- carbon, nitrogen, sulfur and phosphorous.
- (iii) Community ecology – Evaluation, origin, structure, composition and development of community, species diversities in communities, ecotones and the concept of edge effect, ecological niche. (16)

**Systems ecology and ecosystem modeling:**

Development of environmental modeling, scope, types, state of art. (06)

**Biodiversity:**

Concept of biodiversity, types of biodiversity, major biomes distribution. (02)

N.M.U., Jalgaon

**Ecological succession:**

Mechanism of succession, course of succession, types and trends of succession, climax concept in succession, succession and chemical cycling. (05)

**Recommended Books:**

1. K.C. Agrawal, Environmental Biology, Agro-Botanical publishers, Bikaner. (1993)
2. E.P.Odum, Fundamentals of Ecology Revised edition (1995)
3. P.S.Verma, V.K.Agrawal, Environmental Ecology S. Chand & Co., New Delhi.(1998)
4. P.D.Sharma, Ecology & Environment, Rastogi Publications, Meerat.(VII Edi.2000)
5. Eldon D. Enger and Bradley F. Smith, Environmental Sciences, WBC publishers, Boston.(1995)
6. Daniel Botkin and Edward Keller, Environmental Sciences, John wiley & Sons, New York.(1997)
7. R.K. Dixit, Environment, Forest Ecology and Man, Rastogi publication, New Delhi. (1997)
8. S. E. Jorgeson et al, Handbook of Environmental and Ecological Modeling, Levis Publications, New York. (1995)

**EES-103: Environmental Chemistry**

**Fundamentals of environmental chemistry:**

Concept and scope of environmental chemistry, stoichiometry, Gibb's energy, redox potential, chemical potential, chemical equilibria, acid-base reaction, solubility products, solubility of gases in water, definition of environmental terms. (10)

**Atmospheric chemistry:**

Atmosphere- composition, structure, heat balance, chemical composition of air (classification of elements, chemical speciation, particles, ions and radicals in atmosphere), chemical processes for formation of inorganic and organic particulate matter, thermo chemical and photochemical reactions in the atmosphere, oxygen and ozone chemistry. (06)

**Soil chemistry:**

Lithosphere- formation of the earth, zonal structure of the earth and its composition, composition of the earth as a whole, differentiation of elements. Soil and agricultural, nature and composition of soil, acid-base and ion-exchange reaction in soil, macronutrients in soil, NPK in soil, micronutrients in soil. (08)

**Chemistry of water and aquatic system:**

Hydrosphere- characteristic, characteristic and structure of the ocean, snow and ice, fresh water system. Properties of water and their significance, characteristic of water bodies, alkalinity, acidity, calcium and other metals in water, sedimentation, coagulation, organic pollutants in sewage, soaps, oil and detergents, pesticides in water, their classification, radio-nuclide in water (10)

**Analytical environmental data :**

Basic concept and definition, true results, error, types of error, accuracy, precision and standard deviation (02)

**Instrumental techniques in environmental analysis (principle, Instrumentation merits and demerits of techniques):**

Neutron activation analysis, isotope dilution analysis, colorimetry, spectrophotometry, atomic absorption spectrophotometry, flame photometry, gas chromatography, high performance liquid chromatography, ion exchange chromatography and polarography (12)

**Recommended Books:**

1. A.K.De Environmental Chemistry, Wiley Eastern Ltd, New Delhi (2001).
2. G.S.Sodhi, Fundamental concepts of Environmental Chemistry, Narosa Publishing House, New Delhi (2002).
3. F.W. Fifield and P.J. Haines, Environmental Analytical Chemistry, Blackwell Science Ltd. USA (2000).
4. Physicochemical examination of water, sewage and industrial effluent, Pragati prakashan, Meerat, (1996).
5. Standard Methods for the examination of Water and Wastewater, 19th edn, American Public Health Association (1995).

**EES 104: Practical Course on Environmental Chemistry**

1. Calibration of pH meter and determination of pH of the sample
2. Study on molarity, normality and buffers.
3. Estimation of conductivity from the samples
4. Study on physical characteristics of soil.
5. Determination of organic matter by Walkley and Black method from soil.
6. Estimation of dissolved oxygen by Winkler's method.
7. To study principles, component & working operation of flame photometer.
8. To study principles, component & working operation of colorimeter / spectrophotometer.
9. To compare chemical characteristics of soil by rapid tests.
10. Determination of temporary & permanent hardness of water.
11. Demonstration of HPLC for pesticides analysis.
12. Analysis of total dissolved & suspended solids from water.
13. Demonstration of potentiometer - Galvano stat for heavy metal analysis.

**EES 105: Practical Course on Eco-system**

1. Microscopy-
  - a) Use of compound microscopy
  - b) Calibration of microscopy
2. Staining techniques -
  - a) Monochrome staining
  - b) Negative staining
  - c) Gram staining
  - d) Special staining methods
3. Slide culture techniques for examination of fungi / actinomycetes
4. To study the biotic components of a pond ecosystem
5. To compare the biomass and net primary productivity of ungrazed & grazed grassland.
6. To determine the minimum size of the quadrat by 'Species Area Curve' method.

7. To determine the minimum number of quadrats to be laid down in the field under study.
8. Estimation of total viable counts in water and soil samples.
9. Preparation and sterilization of microbial media.
10. Estimation phosphatic fertilizers by colorimetric analysis.
11. Estimation of sucrose from sugar industry effluent.
12. Estimation of protein from leather industry effluent.
13. Practical on ecological modeling.

### SEMESTER - II

<b>EES - 291:</b>	Air and Noise Pollution
<b>EES - 202:</b>	Water Pollution
<b>EES - 203:</b>	Terrestrial Pollution
<b>EES - 204:</b>	Practical Course on Air and Noise Pollution
<b>EES - 205:</b>	Practical Course on Water and Terrestrial Pollution
<b>EES - 201:</b>	Air and Noise Pollution

#### Air pollution:

Definition, natural and man made sources of air pollution, stationary and mobile sources, primary and secondary pollutants, global background concentrations, macro and micro methodological influences, transport and diffusion of pollutants, emission and ambient standards, local regional and global criteria for effects of air pollution, vehicular pollution and urban air quality. (06)

#### Air pollutants:

Sulfur oxides ( $\text{SO}_x$ ); nitrogen oxides ( $\text{NO}_x$ ), carbon monoxide, total suspended particulate matter, respirable particulates, photochemical oxidants, specific pollutants (Hydrogen sulphide, particulate fluoride, formaldehyde and volatile organic compounds), chemical composition of SPM and RSP for toxic trace metals like Pb, Cd, Hg, Ni and Cr. Importance of inorganic ionic composition like  $\text{SO}_4$ , Cl,  $\text{NH}_4$ , Na, K, Ca, Mg and organic acids in aerosols and precipitations, photochemical smog, peroxy acyl nitrates (PAN), benzo- $\alpha$ -pyrene (BAP) formations, atmospheric sinks. (12)



**Global air pollution problems:**

Green house effect (green house gases: CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, CFC's, water vapor concentration, alternatives for CFC's, fire extinguishers), global warming and climate change, ozone layer depletion (ozone depleting processes, ozone hole, environmental effects and strategies for ozone layer protection), acid rain.

(07)

**Effects of air pollution and air monitoring instruments:**

Human health, plants, animals and microbes, archeological monuments and aesthetics, Orsat apparatus, high volume air sampler and source monitors.

(06)

**Air pollution meteorology:**

Wind speed, direction and their vertical profiles, turbulence (mechanical and thermal), atmospheric stability characteristics and classes, Plume behavior, effects of micrometeorology on point source emission, wind-valley effects, land/sea breeze-effects, heat island effect, mixing height-boundary layer definition, temperature inversions, factors affecting on dispersion of air pollutants, micrometeorological instruments.

(09)

**Noise pollution:**

Properties of sound waves, sound pressure and sound level measures, sound level meters, definition of noise, industrial community noise factors, effects of noise on human beings, hearing mechanism, audiometric tests, damage - risk criteria, effects on human performance, noise rating systems, noise standards and guidelines, permissible noise levels for occupational exposures, noise pollution control and abatement measures.

(10)

**Recommended Books:**

1. Magill, Holden and Aekdey, Air Pollution Hand Book, Mc-Graw Hill, New Delhi (1998)
2. R. K. Trivedi & P. K. Goel, An Introduction to Air Pollution, Techno Science Publications, Jaipur (1995)
3. C.S.Rao, Environmental Pollution Control Engineering, New Age International Publication New Delhi (2001)

- 4 A. Sharma & A. Roychaudhari, The Deadly Story of Vehicular Pollution in India, CSE New Delhi (1996)
- 5 Wahi S.K., Agnihotri A. K., and Sharma J.S., Environmental Management, Willey Eastern Ltd., New Delhi. (1992)
- 6 G. N. Pandey, and G.C. Carney, Master Gillbert M., Introduction to Environmental Engineering and Science, Prentice Hall, New Delhi (2000).
- 7 E.Robart Alley and Associates, Air Pollution Control Handbook, Mc-Graw Hill, New Delhi (1998)

#### **EES - 202: Water Pollution**

##### **Characteristics of water and wastewater:**

Physical, chemical, and biological characteristics of water and wastewater, physiochemical and bacteriological sampling and analysis of water quality, quality standards, (BIS, WHO, CPCB and US Environmental Protection Agency), water quality indices: definition, types, applications and significance, water quality for industrial and bathing purpose, prevention and control of water pollution, sewage treatment plant. (08)

##### **Sources of water pollution:**

Sources of water pollution from urban, industrial, agricultural and natural waters, interaction in aquatic system, nature of sources- stationary, intermittent, continuous and mobile, sources of marine pollution, criteria for disposal of pollutants in marine ecosystem, coastal management. (08)

##### **Pollution potential of industrial effluents (Process, sources and characteristics):**

Effluent characteristics- (temperature, exit velocity, concentration and volume). Nuclear/thermal power stations, agriculture, sugar, food processing, chemical, tanneries, pulp and paper, oil and petroleum, textile and electroplating industries. (10)

##### **Water resources and environment:**

Phytoplankton, zooplankton and macrophytes in aquatic ecosystem, global water balance, ice sheets and fluctuations of sea levels, origin and composition of sea water, types of water: surface, ground water, brackish and marine water, human use of surface and ground water, exploration of ground water, ground water table, aquifers, design, construction and maintenance of wells and infiltration galleries. (07)

**Consequences of water pollution:**

Biological uptake of pollutants and their effects on land, vegetation, animals and human health, bio-deterioration, bioaccumulation, bio-magnification and eutrophication, infectious microbial agents in water system and their consequences on human health. (10)

**Bio-indicators :**

Specific pollutants in aquatic system and their speciation, behavior, toxicity and detoxification of pollutants. (Heavy metals, pesticides, fertilizers and radioactive materials). (05)

**Recommended Books:**

1. Gerard Kiely, Environmental Engineering Vol. I, II, & III Liptak, Tata McGraw Hill, New Delhi (1998)
2. A.K. De, Environmental Chemistry. 2nd edn., 1990, Wiley Eastern Ltd., New Delhi.
3. Nancy J. Sell, Industrial Pollution Control, John Willey and Sons, Inc., New York (1992)
4. S.S. Dara A Text Book of Environmental Chemistry and Pollution Control, S. Chand, and Co. Ltd., New Delhi. (1995)
5. P. K. Goal and K. P. Sharma, Environmental Guidelines and Standards in India, Techno science Pub. Jaipur, India (1996)
6. G. R. Pathade, and G. K. Goal, Environmental Pollution and Management of Waste Water by Microbial Techniques, A. B.D. Pub. Jaipur India (2001)
7. S. N. Jodand, Environmental Biotechnology. (Industrial Pollution Management) Himalaya Pub. House Delhi. (1995)

**EES - 203: Terrestrial Pollution**

**Composition of solid wastes:**

Ashes, residues, slag, grit, debris, dirt, masonry, garbage, rubbish, trash, dead animals, abandoned vehicles, bulky wastes, special wastes or hazardous wastes, manures, paper products, rubber, leather, metals, oils, paints, chemicals, explosives and radioactive wastes, industrial waste, agro-waste, sewage treatment residues.

(08)

**Sources of solid waste:**

Urban and rural, agricultural and industrial, demolition, extractive industry, textile, paper and allied products, chemical and agro-chemical, petroleum refining, rubber and plastic products, leather, primary metals, steel plant, ordnance factories, hospitals. (08)

**Collection, transportation and characterization of solid wastes:**

Waste storage devices, collection system parameters, collection equipments, alley, curb, backyard, block and curbside collections, transportation equipments, transfer station, long distance transports, processing of solid wastes for disposal, general properties, physical, chemical and biological properties of solid wastes, Bulkiness, combustibility, solubility, perish ability and disease vectors (08)

**Effects of solid wastes:**

Effects of mining and transportation activities, odour nuisance and occupational hazards, health hazards, social and aesthetic impacts of terrestrial pollution, interaction of terrestrial pollution with air and water pollution, agricultural land and their effects on environment, cost of pollution. (08)

**Pollution from production methods:**

Environmental effects of nuclear, thermal and hydel power production methods, pollution from oil, coal, wood and agro-residues burning, food and chemical manufacturing industries, agro-industries, fertilizers and pesticides, petroleum production, acid plants (08)

**Management of solid wastes:**

Physical methods such as open dumping, sanitary landfill, ocean dumping, incineration, chemical methods such as pyrolysis, biological methods such as composting and vermi-composting, management of hazardous wastes, energy and resource recovery from solid waste management, modern trends in solid waste management, recycling of waste materials, waste minimization technology. (08)

**Recommended Books:**

1. A. D. Bhide and B.B. Sundersen, Solid Waste Management in Developed Countries, INSDOC, New Delhi (1983)
2. Sinha R. K., Sinha A. K., Saxena V. S., A Book on Waste Management, INA, Shri publishers, Jaipur (2000)
3. Robert A. Corbitt, Standard Handbook of Environmental Engineering, Mc-Graw Hill, (1989)
4. E. D. Enger, B.F. Smith, Environmental Science - a study of interrelationships. 5th Edn. W.C.B. Publ., London. (1995)
5. D. Botkin and E. Keller, Environmental Science - Earth as a Living Planet. John Wiley and Sons, Inc., New York, (1997)

**EES - 204: Practical Course on Air and Noise Pollution**

1. Study of micrometeorological equipments.
2. To study principle, components and working operation of respirable dust sampler.
3. To study principle, components and working operation of stack monitoring kit.
4. Determination of NO<sub>x</sub> from ambient air.
5. Determination of SO<sub>x</sub> from ambient air.
6. Determination of RPM & TSPM from ambient air.
7. Construction of windrose and study of wind profiles.
8. Measurement of noise levels.
9. Evaluation of impact of refuse on soil quality
10. Analysis of genetic effects of radiation on microbial systems.
11. Determination of CO<sub>2</sub> & O<sub>2</sub> by Orsat apparatus.
12. Analysis of physical parameters of solid waste.
13. Analysis of chemical characteristics of solid waste.
14. Determination of pollution load through leachate of solid waste dump.

**EES- 205 : Practical Course on Water Pollution**

1. Estimation of chlorides in water sample by Mohr's method.
2. Estimation of residual chlorine in water sample by iodometric method.
3. Estimation of sulphate in water sample by turbidimetric method.
4. Estimation of sulphite in water sample by titrimetric Method.
5. Estimation of ferric and ferrous iron present in water.
6. Estimation of chromium in water.
7. Estimation of nitrate in water.
8. Determination of Chemical Oxygen Demand (COD) in waste water.
9. Determination of Biological Oxygen Demand.(BOD) of a waste water.
10. Determination of Most Probable Number (MPN) in water.
11. Determination of total acidity and  $\text{CO}_2$  in water.
12. Determination of total bacterial and fungal count from garbage piles in housing colonies.
13. Determination of oil/grease in water.
14. Determination of Inorganic Phosphorus in water.