

North Maharashtra University, Jalgaon

Syllabus for

T.Y. B.Sc.

Semester I & II

Environmental Sciences

(With effect from June 2014)

The Structure of T.Y. B.Sc. Syllabus as follows:

Sem. I

(40+10)

Envi- 311: Environmental Pollution – I

Envi- 312: Biodiversity and its Conservation – I

Envi-313: Basic Concept in Environmental Toxicology – I

Envi-314: Remote Sensing & GIS – I

Envi-315: Instrumental Techniques in Environmental Analysis –

Envi-316: Environmental Biotechnology – I

Sem. II

(40+10)

Envi-321: Environmental Pollution – II

Envi-322: Biodiversity and its Conservation- II

Envi-323: Basic Concept in Environmental Toxicology – II

Envi-324: Remote Sensing & GIS –II

Envi-325: Instrumental Techniques in Environmental Analysis – II

Envi-326: Environmental Biotechnology – II

Practical Course

(80+20)

Envi-301: Practical based on theory Subject

Envi-302: Practical based on theory Subject

Envi-303: Practical based on theory Subject

North Maharashtra University, Jalgaon

T. Y. B. Sc. Environmental Sciences Semester – I

Envi-311- Environmental Pollution – I

60 Periods

1. **Introduction to Environmental Pollution:** Definition of pollution, Pollutants, Factors of pollution, Types of pollutants, Levels and Movement of pollutants, Effects of pollution. (14)
2. **Air pollution:** Meaning and definition of air pollution, Sources and Types of air pollutants, Air pollution in India, Adverse effects of air pollution, Smog and Acid rains, Control of air pollution. (14)
3. **Water pollution:** Definition of water pollution, Sources of water pollutants, Types of water pollutants, Nature and types of water pollution, Surface water pollution, Ganga pollution and its control measures, Lake and Ground water pollution, Waste water treatment technology in industries, Primary, Secondary and Tertiary treatment of Sewage Treatment Plants. (16)
4. **Marine pollution:** Introduction, Sources and nature of pollutants, sea water pollution, Industrial waste and sewage sludge, Disposal of plastic litters, Oil pollution and Marine biota, Petrochemicals in the sea, Coral reefs and pollution. (16)

REFERENCES:

- Environmental chemistry by B. K. Sharma, Goel publication house, Meerut, Sixth revised edition – 2001.
- Environmental geography by Savindra Singh, Prayag Pustak Bhavan, Allahabad. Revised edition – 2002.
- Ecology and environment by P. D. Sharma, Rastogi publications, Meerut. Seventh edition – 2004.
- Environmental studies by S. T. Ingle and S. R. Thorat, Prashant publications, Pune, First edition – 2005

Envi-312- Biodiversity and its Conservation - I

60 Periods

1. **Biodiversity I:** Introduction, Definition, Genetic, Species and Ecosystem diversity, Bio-geographical classification of India, India as Mega-diversity Nation, Value of biodiversity, Consumptive and Productive use, Social, Ethical and Optional values. (16)
2. **Bioethics and Conservation:** Key ethical arguments, Causes of extinction, Habitat destruction, Habitat fragmentation, Habitat degradation & Pollution, Introduction of exotic species, diseases, over exploitation, shifting and jhum cultivation. (14)
3. **Endangered and Endemic species:** In India and in World countries, Conservation of biodiversity, In-situ and Ex-situ conservation, Hotspot biodiversity. (14)
4. **Major Environmental movements:** Chipko movement, Silent Valley movement, Appiko movement, Narmada Bachao Andolan, Tehri Dam conflicts and ideological trends in Indian environmentalists. (16)

REFERENCES:

- Environmental chemistry by B. K. Sharma, Goel publication house, Meerut, Sixth revised edition – 2001.
- Environmental geography by Savindra Singh, Prayag Pustak Bhavan, Allahabad. Revised edition – 2002.
- Ecology and environment by P. D. Sharma, Rastogi publications, Meerut. Seventh edition – 2004.
- Environmental studies by S. T. Ingle and S. R. Thorat, Prashant publications, Pune, First edition – 2005.

Envi-313- Basic Concepts in Environmental Toxicology – I

60 Periods

1. **Basic Principles of Toxicology:** Pollutants, Responses to toxic exposure, Duration and frequency of exposure, Dose response relationship, Carcinogens, Mutagens, natural defense mechanism. (16)
2. **Toxic substances:** Environmental toxicant, Bioaccumulation, Bio magnification, toxic residues. (12)
3. **Toxicity:** Factors affecting toxicity of chemicals, Evaluation of toxicity, Bio assay test, Acute and Chronic toxicity. (18)
4. **Toxicology of gaseous pollutants:** Carbon monoxide, Oxides of Nitrogen, Sulphur dioxides, Petroleum and Solvents. (14)

REFERENCES:

- Environmental Toxicology and Chemistry by Donald D Crosby. First edition – 2001.
- Toxicology principle and methods, M. A. Subramaniam, MJP publishers, Chennai. First edition – 2003.
- Environmental toxicology – Satake and Mido Discovery publishing home. New Delhi, Second edition – 2005.
- Toxicology by Sumitro Ghosh, Dominant publishers, New Delhi. First edition – 2005.

Envi-314- Remote Sensing and GIS – I

60 Periods

1. **Fundamentals of Remote Sensing-** Definition, concept and history of remote sensing, Electro-magnetic radiation, Energy interaction with atmosphere, interaction with Earth's surface materials, Spectral reflectance curve, spectral signatures, concept of atmospheric window. (14)
2. **Sensors:** Introduction and types-active and passive sensors, along track and across track scanners, Optical sensor, Microwave sensor, Thermal sensor and Hyper spectral sensor, Sensor resolution- spectral, spatial, radiometric and temporal, Platforms: Introduction and types -Ground based, air borne and space borne platforms. (18)
3. **Satellites:** Satellites types, satellite orbit: geosynchronous and sun synchronous satellites, Indian remote sensing program Characteristics of IRS-P6, High resolution satellites: IKONOS and Quick Bird.
Image analysis: visual and digital, Recognition elements: Tone, Texture, Pattern, Shape, Size, Shadow and Association (12)
4. **Introduction to Geographic Information Systems:** Definition, components of GIS, Concept of map, Map scale and Types of Maps, Data: spatial and non-spatial data, raster and vector data, GIS file formats:, Shapefile and GRID File.
Scanning, Digitization, Geometric transformation, Topology: introduction, relationships and topological errors, attribute data query, spatial data query.
Global Positioning system (GPS) – Introduction. (16)

REFERENCES:

- Textbook of Remote sensing and geographical information systems, M. Anji Reddy (2006), B.S. Publications, Hyderabad
- Remote sensing Principles and applications, Dr. B. C. Panda (2005), Viva books Private New Delhi
- Elements of Photogrammetry, Paul R. Wolf, McGraw-Hill, 2000
- Remote sensing and Image interpretation, Lillesand and Keifer, John Wiley and Sons, 1987
- Introduction to Geographical Information System, Kang- Tsung – Chang, 2002, McGrawHill.
- Geographic Information System- an introduction, 3rd edition, Tor Bernhardsen, Wiley Pub.
- Geographic Information Systems and Science (2nd ed.), 2005, Paul A. Longley, Michael F. Goodchild, David J. Maguire, and David W. Rhind, John Wiley & Sons, Ltd.
- Concepts and techniques of Geographic Information System, C.P.Lo & Albert K.W.Yeung, 2002, Prentice Hall, India.
- Introduction of Geographic Information Systems and Science, Paul A. Lonfley, Michel F. Goodchild, D.J.Maguire & D.W. Rhind, 2002, John Wiley & Sons Ltd.

Envi-315- Instrumental Techniques in Environmental Analysis - I

60 Periods

1. **Instrumental methods of Analysis:** Introduction, Classification of instrumental methods, Components of instruments, Confidence intervals, Detection limit, Precision and accuracy, Constant errors and proportionate errors. (14)
2. **Elementary Electronics:** Semiconductors, Properties of Silicon and Germanium Semiconductor, Semiconductor diodes, Transistors bipolar, Amplifiers, Filters, Voltage regulators, Readout devices. (14)
3. **Electromagnetic Radiation and its Interaction:** Properties of electromagnetic radiation, Wave properties, Particle properties of radiation, Energy units, Electromagnetic spectrum, Polarization of radiation, Absorption of radiation, atomic absorption and molecular absorption, Emission radiation. (16)
4. **Sampling and Basic Concepts in Chemical Analysis:** Basis of sampling, Sampling procedures, Sampling statistics, Hazards in sampling, Standard solutions, Equivalents, Normalities and oxidation numbers, Preparation of standards, Titrimetric Analysis, Gravimetric analysis. (16)

REFERENCES:

- Environmental Science by S. C. Santra, Central Publishing, New Delhi. First edition – 2000.
- Environmental Toxicology and Chemistry by Donald D Crossby. First edition – 2001.
- Toxicology principle and methods, M. A. Subramaniam, MJP publishers, Chennai. First edition – 2003.
- Toxicology by Sumitro Ghosh, Dominant publishers, New Delhi. First edition – 2005.
- Vogel's Textbook of Chemical Analysis, ELBS publisher, Third edition – 2005.
- Instrumental Methods of Chemical Analysis – Willard and Merritt, CBS publisher. Second edition – 2001.

Envi-316- Environmental Biotechnology - I

60 Periods

1. **Introduction:** Scope and importance, Global impact of biotechnology, Healthcare, Agriculture, Environment, Biotechnology in India, Need for future development, Ban on genetic food, Gene bank and Plant conservation. (16)
2. **Biomass:** As an energy source, Composition of biomass, Terrestrial biomass, Aquatic biomass, Saline water hyacinth, Waste as a renewable source of energy, enzymatic digestion. (14)
3. **Biomass energy:** Petroleum plants, Hydrocarbon from higher plants, Alcohol the liquid fuel, Biogas. (14)
4. **Bioremediation:** In situ bioremediation, intrinsic bioremediation, Ex-situ bio remediation, Bioremediation of hydrocarbons – use of mixture of bacteria, Use of genetically engineered bacterial strains. (16)

REFERENCES:

- Fundamentals of Biotechnology by Purohit, Discovery Publishing House. First edition – 2003.
- Biotechnology by RC Dubey S. Chand Publications, New Delhi. Second edition – 2003.
- Advance in Biotechnology by S. N., Jogdand. Himalaya Publishing Publishers, India. First edition - 2001
- Biotechnology fundamentals and applications - Agrobotanical Publishers, India. First edition – 2005.
- Environmental Science by S. C. Santra, Central Publishing, New Delhi. First edition – 2000.

Syllabus for T. Y. B. Sc. Environmental Science

Semester - II

Envi-321- Environmental Pollution - II

60 Periods

1. **Noise Pollution:** Definition of Sound and Noise, Measurement of noise level, Sources of noise pollution, Noise pollution level in India, Effects of noise pollution, Concept of sound, Noise and hearing problems, Measurement of noise pollution, Noise mapping. (16)
2. **Solid Waste:** Introduction, History and origin of solid waste, Methods of solid waste collection, Classification of solid waste, Solid waste treatment methods- Pyrolysis, Incineration, Microbial treatment. (12)
3. **Thermal Pollution:** Introduction, Source and effects of thermal pollution on ecosystem, Hazardous effects, Long term impacts, Process of mixing heated effluents with receiving water, Thermal effects on marine life, Thermal effects on bacteria, Effect on water quality, Thermal effects on man and its environment. (18)
4. **Radioactive Pollution:** Radioactivity, Natural radioactivity, Characteristics of alpha, beta and gamma rays, Radiochemistry, Types of radiochemistry, Radioactive substances, Classification of radioactive isotopes, Case study of radioactive pollution, Chernobyl and Three mile island. (14)

REFERENCES:

- Environmental chemistry by B. K. Sharma, Goel publication house, Meerut, Sixth revised edition – 2001.
- Environmental geography by Savindra Singh, Prayag Pustak Bhavan, Allahabad. Revised edition – 2002.
- Ecology and environment by P. D. Sharma, Rastogi publications, Meerut. Seventh edition – 2004.
- Environmental studies by S. T. Ingle and S. R. Thorat, Prashant publications, Pune, First edition – 2005

60 Periods

1. **Environmental Movement:** Genesis of global environmental movement, environmental resolution- Public Participation, Politics of green movements. (12)
2. **International Agreements and Environmental Awareness:** Earth Summit, Convention of Biodiversity, United Nations Convention on Climate Change, Biodiversity Act (2002). (14)
3. **Protection of Forest:** Introduction, Importance of forest, Forest and Global warming, Forest are carbon sink and sources of carbon, Nature's pollution indicators, Forest; World scene, India's forests, Types of forest, National Forest Policy, Forest conservation through laws, Preservation or Conservation strategies, Forest fire, Forest and Indian population, Heavy loss of green belt, Forest research in India. (18)
4. **Strategies for Wild life:** Introduction, Importance of wild life to man, Reasons for depletion of wildlife, Effects of wildlife depletion, Reasons for wildlife conservation, Categories of Indian wild life, Endangered species, Protected wild life of India, Biosphere research program, Wild life research in India, Wild life education and training. (16)

REFERENCES:

- Environmental chemistry by B. K. Sharma, Goel publication house, Meerut, Sixth revised edition – 2001.
- Environmental geography by Savindra Singh, Prayag Pustak Bhavan, Allahabad. Revised edition – 2002.
- Ecology and environment by P. D. Sharma, Rastogi publications, Meerut. Seventh edition – 2004.
- Environmental studies by S. T. Ingle and S. R. Thorat, Prashant publications, Pune.
- Environmental Science by S. C. Santra, Central Publishing, New Delhi.

60 Periods

1. **Soil toxicology:** Organic and inorganic chemicals in the soil environment. (14)
2. **Effect of Toxic elements for Air and Water:** Lead, Mercury, Arsenic, Chromium, Cadmium, Nickel, Bismuth thallium, Vanadium, Zinc, Copper, Manganese. (16)
3. **Toxicity of Pesticides:** Introduction, Classification of pesticides, Pesticide and human health. (12)
4. **Bio transformation Phase I and Phase II:** Chemical toxicants, Industrial and Agricultural wastes, Ecotoxicology, Public health, Animals in relation to human health, Ecological change and diseases, water relation to human health, Urbanization stress and health. (18)

REFERENCES:

- Environmental Toxicology and Chemistry by Donald D Crosby. First edition – 2001.
- Toxicology principle and methods, M. A. Subramaniam, MJP publishers, Chennai. First edition – 2003.
- Environmental toxicology – Satake and Mido Discovery publishing home. New Delhi, Second edition – 2005.
- Toxicology by Sumitro Ghosh, Dominant publishers, New Delhi. First edition – 2005.

1. **Vector Data Analysis:** Buffering – Variations in Buffering, Overlay- Feature Type and overlay, concept of Distance measurement and concept of Pattern analysis. (14)
2. **Raster Data Analysis:** Data Analysis Environment, Concept of Local Operations, Concept of Physical distance Measurement Operations, Comparison of Vector- and Raster- Based Data Analysis. (14)
3. **Applications of RS and GIS in Agriculture:** Introduction – Agriculture Ecosystems, Yield parameters, identification of crops and acreage estimation, disease identification.

Applications of RS and GIS in Soil Sciences: Introduction –Soil classification, Spectral response curve of soils, soil mapping, mapping and monitoring of degraded land

Applications of RS and GIS in Geo-Disaster Management: Management methods for flood, cyclone, drought, earthquake, volcanism, landslide through RS and GIS. (16)

4. **Applications of RS and GIS in Forestry and Ecology:** Introduction - forest density, Forest type mapping, inventory of forests, delineation of degraded forests, damage assessment, Landscape characterization, Biomass assessment
Applications of RS and GIS in Watershed and Water Resource Management: Sustainable watershed management, Spectral response of pure water, Water pollution detection, Salinity and waterlogged area mapping. (16)

References:

- Introduction to Geographical Information System, Kang- Tsung – Chang, 2002, McGraw Hill.
- Geographic Information System- an introduction, 3rd edition, Tor Bernhardsen, Wiley Pub.
- Geographic Information Systems and Science (2nd ed.), 2005, Paul A. Longley, Michael F. Goodchild, David J. Maguire, and David W. Rhind, John Wiley & Sons, Ltd.
- Concepts and techniques of Geographic Information System, C.P.Lo & Albert K.W.Yeung, 2002, Prentice Hall, India.
- Principles of Geographical Information System, P.A. Burrough & R.A. McDonnell, 2000 Oxford University Press.
- Remote Sensing Applications, P.S. Roy, R.S. Dwivedi, NRSC/ISRO
- Principles & Applications of Photogeology, Shiv N. Pandey, New Age International (P) Ltd.
- GIS for Decision Support and Public Policy Making, Christopher Thomas Jou ESRI Press

Envi-325- Instrumental Techniques in Environmental Analysis - II

60 Periods

- 1. Principle and Applications:** pH meter, Potentiometry, Conductometry, Turbidimetry and Flame Photometry, Bomb Calorimeter, Neutron Activation Analysis, Isotope Dilution Analysis. (16)
- 2. Spectrophotometry:** UV-visible spectrophotometer, Introduction, Single beam/Double beam, Radiation sources, Wavelength selection, Sample containers, Detectors. Atomic absorption spectrophotometer-Introduction, Radiation sources, Wavelength selection, Sample containers, Detectors. Introduction to Inductively Coupled Plasma Optical Emission Spectroscopy (ICPOES). (18)
- 3. Chromatography:** An introduction of chromatography, Classification of separation methods, Classification of chromatography, Qualitative and quantitative analysis. Column chromatography, Liquid-liquid Partition chromatography, Ion exchange, Thin layer, Paper, Gas Chromatography and HPLC, Electrophoresis. (16)
- 4. Environmental Statistics:** Fundamental of Statistics- Mean, Mode, Median and Variance. (10)

REFERENCES:

- Environmental Science by S. C. Santra, Central Publishing, New Delhi. First edition – 2000.
- Environmental Toxicology and Chemistry by Donald D Crosby. First edition– 2001.
- Toxicology principle and methods, M. A. Subramaniam, MJP publishers, Chennai. First edition – 2003.
- Toxicology by Sumitro Ghosh, Dominant publishers, New Delhi. First edition– 2005.
- Vogel's Textbook of Chemical Analysis, ELBS publisher, Third edition –2005.
- Instrumental Methods of Chemical Analysis – Willard and Merritt, CBS publisher. Second edition – 2001.
- Biodiversity by P. Ramakrishnan, Saras Publications, 2010

Envi-326- Environmental Biotechnology - II

60 Periods

1. **Bioremediation Toxicity:** Bioremediation of heavy metals, Bioremediation of dyes, Genetic modification in industrial effluents, Wastewater treatment technology, Role of microbes in effluents. (14)
2. **Bioremediation:** Xenobiotics, Gene manipulation of pesticides regarding microorganisms. (12)
3. **Bioremediation:** Microorganism used in leaching direct leaching and indirect leaching of Copper, Uranium, Gold, Silver etc. (16)
4. **Hazards of Environmental engineering:** Survival of gene modified microorganisms in the environment, Adaptive mutagenesis, Effect of environmental factors on gene transfer, Ecological impacts of gene modified microorganisms released in the environment, Growth inhibition of natural strains, Replacement of natural strains. (18)

REFERENCES:

- Ecology and environment by P. D. Sharma, Rastogi publications, Meerut. Seventh edition – 2004.
- Environmental studies by S. T. Ingle and S. R. Thorat, Prashant publications, Pune, First edition – 2005.
- Fundamentals of Biotechnology by Purohit, Discovery Publishing House. First edition – 2003.
- Biotechnology by RC Dubey S. Chand Publications, New Delhi. Second edition – 2003.
- Advance in Biotechnology by S. N., Jogdand. Himalaya Publishing Publishers, India. First edition - 2001
- Biotechnology fundamentals and applications - Agrobotanical Publishers, India. First edition – 2005.
- Environmental Science by S. C. Santra, Central Publishing, New Delhi. First edition – 2000.

Envi-301- Practicals based on theory subject

100 marks

Semester - I

1. Determination of Colour of Industrial effluents.
2. Determination of Conductivity.
3. Determination of Volatile Solids.
4. Study of Safety Instructions
5. Determination of Dissolved oxygen by DO meter.
6. Determination of Residual chlorine.
7. Determination of Available chlorine.
8. Determination of Turbidity by Turbidity meter.

Semester - II

1. Determination of Phosphate from the water.
2. Determination of Nitrate from the water.
3. Determination of Sulphate from the water.
4. Determination of Ammonia from the water.
5. Estimation of coliform bacteria from water by MPN test.
6. Study of Quality criteria of Water for Drinking Purpose
7. Study of Quality criteria of Water for Industrial and other Purpose

Envi-302- Practicals based on theory subject

100 marks

Semester - I

1. Study of effect of Sulphur dioxide / Hydrogen sulphide on plants
2. Demonstration of HVS for estimation of Suspended particulate matter.
3. Determination of Noise level.
4. Demonstration of Spirometer for use in occupational health
5. Determination of requisite size and number of quadrats to be laid down for studying vegetation.
6. Determination of Density, Abundance and Frequency of component species in a Grassland community.
7. Estimation of Primary productivity.
8. Determination of Chlorophyll-*a* content of a given sample.

Semester - II

1. Determination of soil bulk density
2. Estimation of Organic carbon.
3. Ecological adaptations of Xerophytes.
4. Ecological adaptations of Mesophytes.
5. Ecological adaptations of Hydrophytes.
6. Determination of Sludge Volume Index.
7. Study of quality criteria of Air and Noise pollutions.

Envi-303- Practicals based on theory subject

100 marks

Semester - I

1. Nitric acid digestion for metal analysis
2. Nitric acid and Hydrochloric acid digestion for metal analysis
3. Nitric acid perchloric acid digestion for fluoride analysis
4. Nitric acid sulphuric acid digestion for metal analysis
5. Study and demonstration of Atomic Absorption Spectrophotometer
6. Study and Demonstration of UV-visible spectrophotometer
7. Study and demonstration of Flame Photometer
8. Estimation of Sodium / Potassium by Flame Photometer from the provided sample.

Semester - II

1. Study and Demonstration of Bomb calorimeter.
2. Estimation of Chlorophyll content by TLC method
3. Study and Demonstration of Gas Chromatography
4. Computation of Mean, Median, Mode and Variance of the given environmental data set.
5. Study of Satellite Image
6. Study of Thematic Map
7. Demonstration on the use of GPS.

Scope and Job Opportunities (B.Sc. Environmental Sciences)

The issues associated with the environment are continuously increasing due to development in all the sectors. Developments in industrial, agricultural, urbanization and over increasing human population are responsible for degradation of Environment. The course B.Sc. Environmental Sciences is designed in such way that the human resource required for environmental management will be developed in near future. The syllabus was developed by keeping in mind the need of industrial, agricultural and other developmental sectors. The job opportunities for the students of B.Sc. Environmental Sciences are as follows:

1. Industries
2. Pollution Control Boards
3. Water and Land Resource Management Sector
4. Ministry of Environment and Forests
5. Environmental consultancies

The graduate in environmental sciences will be absorbed as ETP operators/wastewater managers / safety and health department in the industries. These experts will be also absorbed in pollution control boards as a field officer/environmental chemist.