**PG. DEPARTMENT OF ENVIRONMENTAL SCIENCE**

# M. Sc. Environmental Science

**PROGRAMME OUTCOMES (PO'S)**

The post graduates are able to

1) Acquire in–depth knowledge and integrate with existing knowledge to sensitize the people about global and local environmental issues.
2) Develop an ability to identify, critically analyse, formulate and solve environmental problems using basic principles of nature conservation.
3) Get acquainted with environmental and social impacts of any developmental activity.
4) An ability to design a system and process to meet desired needs of society within realistic limitations such as health, safety, security and environmental considerations.
5) An ability to design and conduct experiments, interpret data, and provide well informed conclusions.
6) Communicate effectively socio-economic problems related to environment by appropriate documentations and presentations.
7) Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8) Apply ethical principles and commit to professional ethics and responsibilities and follow the norms of the any surrounding practice.

**PROGRAM SPECIFIC OUTCOMES (PSO's):**

**I: Professional skills -**Ability to monitor the present status of environmental parameters through monitoring for design and development of new concept or technology.

**II: Industrial Skills-** Successfully tackle with the industrial pollution problems through appropriate technology and tools.

**III: Environmental and Social values within individual** -Inclusion of environmental and social values within the individual's life.

**IV: Problem solving approach:** Identify, formulate, review literature and analyse complex environmental problems and suggest suitable solutions reaching substantiated conclusions using first principles of natural science.

**V: Successful development of Career and Entrepreneurship** -To prepare the students with broad environmental perspective and become a successful in career and entrepreneurship.

**VI: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with understanding of the limitations.

# Syllabus – M.Sc. Environmental Science

**M.Sc. Part I -Semester I**

| Sem. I Course Code | Paper No. Title of the Course | Instruction Hrs./ Week | Duration of Exam (hrs.) | Marks Term end Exam | Marks Internal Assessment | Credits |
|---|---|---|---|---|---|---|
| | **Compulsory Courses** | | | | | |
| 1.1 Hard core | Introduction to Environmental Science | 4 | 3 | 80 | 20 | 4 |
| 1.2 Hard core | Environmental Chemistry | 4 | 3 | 80 | 20 | 4 |
| 1.3 Hard core | Environmental Geoscience & Climatology | 4 | 3 | 80 | 20 | 4 |
| 1.4 Hard core | Environmental Biology and Conservation | 4 | 3 | 80 | 20 | 4 |
| 1.5 Softcore | Remote sensing & GIS | 2 | 2 | 40 | 10 | 2 |
| 1.6 | Practical 1- based on Environmental Chemistry | 4 | 2 | 40 | 10 | 2 |
| 1.7 | Practical 2 - based on Environmental Geoscience & Climatology | 4 | 2 | 40 | 10 | 2 |
| 1.8 | Practical 3 - based on Environmental Biology and Conservation | 4 | 2 | 40 | 10 | 2 |

**M.Sc. Part I -Semester II**

| Sem. II Course Code | Paper No. Title of the Course | Instruction Hrs./ Week | Duration of Exam (hrs.) | Marks Term end Exam | Marks Internal Assessment | Credits |
|---|---|---|---|---|---|---|
| | **Compulsory Courses** | | | | | |
| 2.1 Hard core | Environmental Biotechnology and Microbiology | 4 | 3 | 80 | 20 | 4 |
| 2.2 Hard core | Environmental Engineering | 4 | 3 | 80 | 20 | 4 |
| 2.3 Hard core | Environmental Pollution | 4 | 3 | 80 | 20 | 4 |
| | **Open Elective Course** | | | | | |
| 2.4 | Environment & sustainable development | 4 | 3 | 80 | 20 | 4 |
| | **Compulsory Courses** | | | | | |
| 2.5 Softcore | Education for sustainable development | 2 | 2 | 40 | 10 | 2 |
| Practical 2.6 | Practical 4- based on Environmental Biotechnology and Microbiology | 4 | 2 | 40 | 10 | 2 |
| Practical 2.7 | Practical 5 - based on Environmental Engineering | 4 | 2 | 40 | 10 | 2 |
| Practical 2.8 | Practical 6 - based on Environmental Pollution | 4 | 2 | 40 | 10 | 2 |

# Syllabus – M.Sc. Environmental Science

## M.Sc. Part II -Semester III

| Sem. III Course code | Paper No. Title of the Course | Instruction Hrs./ Week | Duration of Exam (hrs.) | Marks Term end Exam | Marks Internal Assessment | Credits |
|---|---|---|---|---|---|---|
| | **Compulsory Courses** | | | | | |
| 3.1 Hard core | Solid and Hazardous Waste Management | 4 | 3 | 80 | 20 | 4 |
| 3.2 Hard core | Natural Resource Management & sustainable development | 4 | 3 | 80 | 20 | 4 |
| 3.3 Hard core | Research Methodology & Statistics | 4 | 3 | 80 | 20 | 4 |
| | | | | | | |
| | **Open Elective Course** | | | | | |
| 3.4 | Climate change and environment | 4 | 3 | 80 | 20 | 4 |
| | **Compulsory Courses** | | | | | |
| 3.5 Softcore | Disaster management | 2 | 2 | 40 | 10 | 2 |
| Practical 3.6 | Practical 7- based on Solid and Hazardous Waste Management | 4 | 2 | 40 | 10 | 2 |
| Practical 3.7 | Practical 8 – based on Natural Resource Management & sustainable development | 4 | 2 | 40 | 10 | 2 |
| Practical 3.8 | Practical 9 – based on Research Methodology & Statistics | 4 | 2 | 40 | 10 | 2 |

**M.Sc. Part II -Semester IV**

| Sem. IV Course code | Paper No. Title of the Course | Instruction Hrs./ Week | Duration of Exam (hrs.) | Marks Term end Exam | Marks Internal Assessment | Credits |
|---|---|---|---|---|---|---|
| | **Compulsory Courses** | | | | | |
| 4.1 Hard core | Environmental Law & Policy | 4 | 3 | 80 | 20 | 4 |
| 4.2 Hard core | Environmental Planning & Management | 4 | 3 | 80 | 20 | 4 |
| 4.3 Hard core | Environmental Toxicology & occupational health hazards | 4 | 3 | 80 | 20 | 4 |
| 4.4 Hard core | Nanotechnology & Environment | 4 | 3 | 80 | 20 | 4 |
| Practical 4.5 | Practical 7- based on Environmental Planning & Management | 4 | 2 | 40 | 10 | 2 |
| Practical 4.6 | Practical 8- based on Environmental Toxicology & occupational health hazards | 4 | 2 | 40 | 10 | 2 |
| 4.7 | Project / Dissertation | 4 | Viva | 80 | 20 | 4 |

**Total Course credits = 96**

SKE's

**GOVINDRAM SEKSARIA SCIENCE COLLEGE, BELAGAVI (AUTONOMOUS)**

**M. Sc. Environmental Science (2024-25 onwards)**

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**QUESTION PAPER PATTERN**

**PAPER CODE: –**
**Title of the paper:**

**Time: 3 Hour** **Max. Marks: 80**

**I. Answer any TEN of the following** **10 × 2=20**

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.

**II. Answer any FOUR of the following** **4 × 5 = 20**

13.
14.
15.
16.
17.
18.
19.

**III. Answer any FOUR of the following** **4 × 10 = 40**

20.
21.
22.
23.
24.
25.

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The project work shall carry 100 marks (IA-20; Dissertation copy – 50; Viva-voce – 30 marks)

## 1.1 - Introduction to Environmental Science

Credits- 4 Teaching hrs/week = 4 hrs 60 hrs

**COURSE OUTCOMES:**

- Understand the basic concepts of environmental science
- Discuss various global environmental issues
- Discuss the human impacts and consequences on the environment
- Understand the concept of carrying capacity

**Unit -1 (15 hrs)**

**a) Introduction to Environmental Science:**

Meaning, scope and interdisciplinary nature of Environmental Science, principles background and scope of environmental science, Environmental Science and technology, Media and people, decision making and applications of Environmental Science.

Environmental history – Geo timescale, supercontinent, plate tectonics, continental drift etc. major extinction events, Anthropocene.

**b) Environmental ethics:**

Nature and origin of environmental ethics, ecological consciousness, western and Eastern views, philosophy of environment, Environment, community and equity, Integrating ethical values and knowledge, self centered development and environment.

**Unit- 2 Global and national environmental issues: (15 hrs)**

Greenhouse effect, Acid rain, Global Warming, Ozone depletion, Climate change, Carbon footprint, Deforestation, Biodiversity loss, Desertification**. E**cological and environmental security, Climate change - status, impact, adaptation, mitigation

Political ideologies and environment, Major Environmental movements,

**Unit -3 Human impact on environment and its consequences (15 hrs)**

Hunting and gathering, agriculture societies, Human history Rise and Fall of civilisations, Age of colonisation, industrial societies, impact of cultural change on environment, population explosion, degradation of natural resources, pollution of air, water and soil, urbanization, industrialization, public health, energy crises. Agricultural history.

Interrelationship among environment; economic and social issues. Rapid technological innovation; explosion in energy use and economic integration.

**Unit- 4 Concept of carrying capacity (15 hrs)**

Biotic and abiotic components of environment, concept of sustainability and carrying capacity, tragedy of commons, human population and food security, water and energy security, present status of environment and future scenarios. Earth over shoot day.

Consequences of degradation on environmental quality and sustainability.

Systems thinking and environment. Agenda 21.

**References:**


1. Environmental Science - Arms Karen
2. Principles of Environmental Science-Watt, K. E. F. (1973) McGraw-Hill Book Company.
3. Environmental Science –Noble, B .J. Kormandy, E.J.(1981),The way world works, Prentice-Hall Inc., N .J.
4. Environmental Science-Turk A. , Turk J. Wittes J.T. and Wittes, R.E.
5. Environmental Issues: Measuring, Analyzing, Evaluating, Abel, Daniel C. McConnell, Robert L. Abel, Daniel C. Edi. 2 Prentice Hall Publication
6. Botkin Daniel. B and Edward. A. Keller, Environment Science – Earth as a living Planet, John Wiley and Sons, 2005.
7. Miller, G., Spoolman, S., 2007. Environmental Science: Problems, Connections and Solutions. Cengage Learning.

## 1.2- Environmental Chemistry

Credits- 4 Teaching hrs/week = 4 hrs 60hours

**COURSE OUTCOMES:**

- Understand the principles and basics of chemical reactions related to the environment.
- Understand the fundamentals of environmental chemistry with reference to atmospheric and water chemistry.
- Discuss air pollutants and their reactions in the atmosphere.
- Build scientific temper and to learn the necessary skills to succeed in research or industrial field.

**Unit – 1 - Concept and scope of Environmental Chemistry (15 hrs)**

a) Concept and scope of Environmental Chemistry, Chemistry of environmental segments - lithosphere, hydrosphere, atmosphere. Biosphere and their ecological significance.

b) Basic concepts of Environmental Chemistry:

Role and importance of Environmental Chemistry. Entropy, Gibb's energy; chemical potential; Thermodynamic equilibria. Law of conservation of mass. Solubility product; unsaturated and saturated hydrocarbons, radionuclide's, radioisotopes

**Unit -2 - Chemistry of Air, Water and Soil (15 hrs)**

a) Chemistry of Air: Classification of elements in air; composition of air; Temperature variation with altitude- green house effect, 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, Oxygen and ozone chemistry; chemistry of air pollutants; photochemical smog.

b) Chemistry of water and soil:

Chemistry of water, structure of water molecule, pollution load and self purification property. water quality parameters, solubility of gases in water, carbonate system,

Chemistry of soil, Soil profile, Inorganic and organic components of soil, effect of pH on soil fertility. Chemical -biological factors affecting the soil quality, adsorption of contaminants in soil, Effect of modern agro-technology on quality of soil.

Heavy metal accumulation – contamination, bio-mining, and heavy metal accumulating plants

**Unit – 3 (15 hrs)**

a) Chemistry of Organic and Inorganic chemicals in the Environment

Organic chemicals in the environment, soaps, detergents, polymers, drugs, dyes, oil and grease, Inorganic gaseous pollutants, Particulate matter, toxicity of heavy metals. Inorganic pesticides, Persistent organic pesticides and fertilizers.

b) Environmental monitoring and sample analysis

Sampling of air and water pollutants, CPCB guidelines, monitoring of AAQ and pollutants from stationary source. Monitoring techniques and methodology, pH, Chemical oxygen demand (COD), Biological Oxygen Demand (BOD), Speculation of metals, monitoring and analysis of CO, NOx, SOx, pesticide residue, residual chlorine, phenolic compounds and Volatile organic compounds.

**Unit – 4 Instruments used in environmental monitoring (15 hrs)**

Theory; principle; working and applications of following sampling instruments: HVAS/ RDS, Stack monitoring, weather monitoring, pH meter; EC meter; DO meter; Nephlometer, Colorimeter; Atomic Absorption Spectroscopy (AAS), Flame photometry, X-ray Fluorescence, UV-Visible spectrophotometer, IR Spectroscopy, High performance liquid chromatography (HPLC), Gas chromatography (GC), NMR etc.

References:


1. Environmental Chemistry by B. K. Sharma S. H. Kaur Goel Publishing House, Meerut
2. Anil Kumar De, 2003. Environmental Chemistry, New Age International Limited Publishers, 5th edition.
3. Toxic Chemicals, health and the Environment, Lave, L.B and Upton, A.C. 1987. The Hopkins Press Ltd., London.
4. Vogel's Textbook of quantitative Chemical analysis, 5th Edition-J. H. Basett, J. Nendham and Denny, R.C.
5. Instrumental Methods of analysis – Chatwal and Anand
6. Chemistry for Environmental Engineering, C. N. Sawyer and P L Mc Carty, McGraw Hill Kogakusha ltd., 1990.
7. Fundamentals of Analytical Chemistry, 1982.Hobert H. Willard D.L. Merrit and J. R. J. A. Dean.
8. Spiro G and William M. Stigliani, 2002. Chemistry of the Environment, Thomas, Hall of India Pvt. Ltd, 2nd edition.
9. Yadav L., Singh J., Srivastava J., 2014. Advanced practical's of chemistry Pragati Prakashan

## 1.3 - Environmental Geoscience & Climatology

Credits- 4 Teaching hrs/week = 4 hrs 60 hours

**COURSE OUTCOMES:**

- Study the basic aspects of environmental geology.
- Describe the structure and processes of earth.
- Discuss about the importance of mineral resources and the probable impact on environment by their exploitation.
- Know the various mineral resources available on earth.
- Able to depict / analyse the Toposheets.

**Unit 1 –** 15 Hours

Environmental Geology; Definition, objectives, scope and necessity, Origin of the Earth. Interior of the Earth. Earth systems and its interaction with lithosphere, atmosphere, hydrosphere and biosphere, Earth's Processes Endogenic and Exogamic Earth's processes and hazards: Weathering; type of Weathering, Erosion, Plate tectonics, Geological action of River, Wind, Glaciers and Ocean. Natural Hazards; Earthquakes. Tsunami, Volcanic eruption, Floods, landslides, cyclone, avalanche and their impact on Environment. Human Impact on Geological Processes: Land use changes, mining, urbanization, and their effects on Earth's systems.

**Unit 2:** 15 Hours

Earth's Materials Minerals and their definition. Distribution and abundance of elements in the Earth's crust. Concepts of major, trace and RE elements, Classification of trace elements. Mobility of trace elements, Human use of trace elements and health. Geochemical cycles (carbon, nitrogen, phosphorus, and sulfur cycles). Formation and classification of Rocks. Rock Cycle. Geological Formations and their environmental significance; Folds, faults, joints and unconformity.

Water Resources; Hydrological cycle, surface water, and groundwater. Human usage of surface and Groundwater. Aquifers and groundwater recharge, Groundwater Potential. Global water balance, types of water, Physicochemical characteristics and composition of sea water, Rain water, River water, Ground water.

**Unit 3:** 15 Hours

Mineral resources. Resources and Reserves. Environmental uses of minerals and rocks, Depletion trends of natural resources, Environmental impact of Exploitation resources. Geological features of India and Karnataka. Pedology; formation of soil, Soil profile, Soil characteristics, role of soil organisms in soil formation, soil erosion, types and classification, soil conservation methods.

Land use Planning and management; Zoning, land-use practices, and sustainable land management. Topographical studies of different land surfaces Environmental aspects of terrain evolution, Methods of site selection and evaluation of land in environmental planning.

**Unit 4-** 15 Hours

Atmosphere, structure, composition and dynamics; The vertical structure of atmosphere, composition of earth's atmosphere, thermal stratification, the ionosphere, D.E.F. and G regions, energy transfer near earth's surface, insolation, terrestrial radiation and heat balance of the earth.

Climate, weather, measurement of climatic parameters; Concept of Weather, Climate, Meteorology and Climatology, Elements of Weather, Measurement of premise – Temperature, Air pressure, Turbulence, Wind, Rain, Humidity and Radiation. Wind systems of the world, El Nino, Monsoon phenomenon and its role in Indian subcontinent.

Bioclimatic variables and online databases,

Fossils, paleoclimate, carbon dating, reconstruction of past environment.

References:

1. Ecology and Environment, P. D. Sharma, Ashish publications, 1994.
2. .Ground water Hydrology by D..K..Todd John Wiley and Sons.
3. Ground water contamination (Transport and remediation) by Philp Bedient, Hanadi.
4. S. Rifai and Charles. Publishers: Prentice Hall.
5. Environmental Hydrology by Andy. D. Ward and William J..Elliot, Lewis
6. Environmental Geography, Valdia ,K..S(1987)
7. Environmental Geography, Savindra Singh
8. Environmental Geology,Keller E.A. and Turk and Turk
9. Introduction to weather and climate-Trewartha
10. Physical Geography - S. Strahler, John Wiley and Sons,

## 1.4 - Environmental Biology and Conservation

Credits- 4 Teaching hrs/week = 4 hrs 60 hours

**COURSE OUTCOMES:**

- Students will be able to articulate the basic structure, functions and processes of systems affecting the environment.
- Gain knowledge about environmental factors and its impact on life systems.
- Give basic knowledge about biological interactions in an environment.
- Helpful in the assessing the impact of environmental factors on plants and animals

**Unit – 1 - Biomes of the world:** (15 hrs)

Bio-geographical realms, Classification of biomes – Tundra, Taiga, Grassland, Desert, Evergreen and deciduous forests, Tropical rain forests and their characteristics, flora and fauna; Classification of Aquatic Habitats – Fresh water pond, Wetlands, Rivers – their characteristics, flora and fauna; Marine Habitats – Pelagic, Benthic, Inter-tidal Estuarine; Mangroves ecosystem, flora and fauna of India. Biogeography of ecosystems in India.

Concept of Bioindicators, Bio-indicators as plants, animals, Ecosystem services and ecosystem dynamics, Ecosystem functioning and ecosystem services provided by different ecosystems at present – provisioning services, regulating services, habitat or supporting services, cultural services

**Unit – 2 Fundamentals of Ecology (15 hrs)**

Definition of ecology and sub divisions, Relation to other sciences, Relevance to civilization, levels of organization, hierarchy, Cake and other ecological models, Concept of ecosystem, its structure and function, cybernetic nature and stability of Ecosystem, Energy in ecological systems, concept of productivity, food chains, food web and trophic levels, ecological pyramids, Concept of habitat, niche and guild, concept of ecotone and edge effect, succession, natural selection, Concept of Gaia hypothesis.

Limiting factors and their tolerance- Liebig's law of minimum, Shelford's law of tolerance, limiting factors - temperature, radiation, and water, micronutrients etc.

**Unit – 3 – Population & System ecology (10 hrs)**

a) Population and community ecology- Basic concepts of population ecology, population dynamics, growth curves, characteristics of population: natality, mortality, fecundity, density, age distribution, relationships among organisms, mechanisms of competition (Inter and intraspecific), population explosion, Community types and community composition.

b) System ecology and ecosystem modelling

Basic concepts of system ecology, Ecosystem modelling, compartmental system approach, Experimental components approach, simulation, System analysis. Lotka-Volterra Model, Niche and types, Environmental Niche Conservatism, Carrying capacity, ecological opportunity, Key Innovation. Species distribution modeling, MaxEnt and Wallace EcoModel

**Unit – 4 Biodiversity & Conservation (14 hrs)**

Biodiversity as life support system for man, types of biodiversity, ecosystem, species and genetic, Values of biodiversity, Indian ethos of wildlife conservation, Hotspots of Biodiversity, Causes for loss of biodiversity, measurement of biodiversity; IUCN criteria, Red list,

Criteria for conservation, Approaches to conservation, Design criteria(habitat constituents, reserve design, reserve shape and size, population size, need for buffers, wildlife corridors, landscape connectivity, administrative, political and economic considerations), Methods of biodiversity conservation – in situ conservation (sanctuaries, national parks and biosphere reserve); ex situ conservation (zoo, botanical gardens; gene/germ plasma banks), Convention on Biological Diversity (CBD), Biodiversity conservation efforts in the country.

References :


1. Ecology - E.P. Odum, 1983, Holt-Saunders International Edition
2. Concepts of Ecology. E. J. Kormondey, 1984. Indian reprint 1991 Prentice-Hall of India.
3. Ecology and Environment, P. D. Sharma, Ashish publications, 1994.
4. Alfred J. R.B, A.K.Das and A.K.Sanyal, Ecosystems of India, ZSI, 2001.
5. Banarjee A., 2010, Footprints in the forest, Winrock International India.
6. Botkin Daniel. B and Edward. A. Keller, Environment Science – Earth as a living Planet, John Wiley and Sons, 2005.
7. Carabias Julia and Kishore Rao, Capacity Needs to Manage Protected Areas, The Nature Conservancy, 2003.
8. Champion S,. Seth S, (2005). Revised survey of forest types of India. Nataraj Publishers, New Delhi.
9. Gopal, R., 2011. Fundamentals of Wildlife Management. Natraj Publishers, New Delhi.
10. Grimmett R., Inskipp C. and Inskipp T. (2001) Pocket Guide to the Birds of the Indian Subcontinent, Oxford University Press, Oxford.
11. Groom M.J., MeffeG.K. and Carroll C.R. (2006) Principles of Conservation Biology (3rd edition), Sinauer Associates, Sunderland
12. Hunter Malcom. Jr, Maintaining Biodiversity in Forest Ecosystems, Cambridge University Press, 1999.
13. J. B. Lal, 1992, Forest ecology, Natraj publishers.
14. Kamaljit S. B., et. Al., 2011, Conservation Biology, Universities Press.
15. Keddy Paul. A, Wetland Ecology – Principles and Conservation, Cambridge University Press, 2000.
16. Menon, V., 2014. Indian mammals: a field guide. Hachette India.
17. Sawarkar, V.B., 2005. A guide to planning wildlife management in protected areas & managed landscapes. Natraj Publishers.
18. Sharma, B.D., Karthikeyan, S., Singh, N.P., Flora of Maharashtra State. Botanical Survey of India.
19. Slootweg R., Rajvanshi A., Mathur V., Kolhoff A., 2009. Biodiversity in Environmental Assessment: Enhancing Ecosystem Services for Human Well-Being. Cambridge University Press.
20. Sutherland, William J. 2006. Ecological Census Techniques: A Handbook. Cambridge University Press.
21. Townsend Colin. R, John. L. Harper and Michael Begon, Essentials of Ecology, Blackwell Science, 2000.
22. Alexander, M. Management Planning for Nature Conservation: a Theoretical Basis & Practical Guide. Springer, 2008.

**1.5 - Remote sensing and GIS**

**Soft core - Credits -2 , Hours of Instruction - 2hrs/Week, 30 hrs/semester**

**COURSE OUTCOMES:**

- To have a fundamental knowledge of Remote sensing and GIS.
- Know the applications of remote sensing and GIS in environmental science.
- Gain knowledge about sensors, its types and applications.
- Develop understanding about the applications of Remote sensing and GIS in Resources management, monitoring of wildlife and management.

**Unit 1 - 10 hours**

Introduction to remote sensing: Definition, basic concepts and history; characteristics of Electromagnetic Radiation – Interactions between matter and electro-magnetic radiation - Fundamentals of aerial photography .

Sensors: Types of sensors, concept of Resolution – Spatial, Spectral, Temporal and Radiometric. Basic concept and principles of thermal, microwave and hyperspectral sensing, SAR, SLAR, RADAR, LiDAR and hyperspectral sensing, spectral reflectance and their characteristics of Earth surface features.

Remote sensing satellites – types and their characteristics – Low earth orbit, sun - synchronous, geosynchronous and geostationary satellites;

GPS – Principles, orbital geometry, measurements and accuracy, Indian Space programmes

**Unit 2 - 10 hours**

Products used in Remote sensing,- Images, scale, mosaics, time and seasons of orbital cycles. Aerial photographs, photographic systems, Satellite data products. Photogrammetry - Basic principles, types, steps and elements of image interpretation, visual interpretation, interpretation equipment - digital image processing- image rectification, enhancement, supervised and unsupervised classification

**Unit 3 - 10 hours**

GIS - Definitions, History, development and components; GIS data: spatial and non-spatial data – sources and quality; linking of spatial and non-spatial data - geo-referencing and Map scale; Data processing - Spatial and attribute data acquisition; verification Spatial and non

Applications of Remote sensing and GIS - Management and monitoring of Environment, landuse/land cover mapping conservation of resources, natural resources, flood, fire, coastal zone, disaster management.

Spatial data model- raster, vector, Topology and topological models - TIN and DEM, NDVI etc.

**Reference :**


1. Environmental Radioactivity from Natural, Industrial and Miltry sources, Merril Eisenbud and Thomas Gessell Academic Press, London
2. Radiation and Man – Jain.H.C, National Book trust, New Delhi
3. Remote Sensing a better view – Rudd.R.D. (1974)
4. Remote sensing techniques for Environmental Analysis, Estes. J.E. and Senger.L.W
5. Remote sensing of Environment – Lintz.J and Simonnet.D.S (1976)
6. Remote Sensing and GIS for Environmental Planning – Murli Krishna.I.V. (1995).
7. Essential of Remote Sensing – (S.Srikantaswamy 2008)
8. AnjiReddyM.(2000). Remote Sensing and Geographical Information Systems: An Introduction. Book Syndicate.
9. RobertG.Reeves(Ed). (1983), Manual of Remote Sensing, Johm Wiley and Sons, NewYork.
10. Morris M. Thomson(Ed). (1988). Manual of Photography. TataMcGraw-Hill. PublishingCo.
11. Berry. S Siegal and Allen R. Gillspie. (1987). Remote Sensing in Geology,TataMcGraw-Hill.PublishingCo.
12. LeuderrD.R.(1993). Aerial Photography interpretation – Principles and Applications, McGraw–Hill.
13. Lilles and Kiefer.(1993). Principles of Remote Sensing
14. Nag Pand Kudrat M. (1998). Digital Remote Sensing. Concept Publishing Co., New Delhi.
15. Chouhan and Joshi K.N.(1996). Applied Remote Sensing and Photo interpretation.
16. Rajan M.S.(1991). Remote Sensing and GIS for Natural Resources.
17. Narayana L. R. A ( 1999). Remote Sensing and its application, University Press(India).
18. Lilles and T.M.(1987). Remote Sensing and Image interpretation. John Wiley,Hamburg.
19. Sabins F. F and Floyd F.J.R. (1978). Remote Sensing- Principles and interpretations.
20. Burroguh P. A and McDonnellR.A. (1988). Principles of Geographical Information system. Oxford Univ.Press.
21. Jorgevsen S.E.(1996). Applications of ecological modelling in environmental management. Elsevier Sci.Co., London.
22. Muralikrishna I.V. (2001). Spatial Information Technology- RS and GIS. Vol.Iand IIBS Publications,Hyderabad.
23. BurroughP.A.(1986). Principles of GIS for Land Resource Assessment. Oxford University Press.

Elachi C. (1978). Introduction to Physics and Techniques of Remote sensing. John Wiley Publication New York.

**Semester I**

**Practical 1.6 (based on 1.2)**

1. Determination of pH and Conductivity of different water and soil samples
2. Determination of calcium and magnesium by EDTA complex metric method
3. Determination of Carbonates and Bicarbonates in water samples
4. Determination of Chloride in water sample
5. Estimation of Iodine value of given oil sample
6. Determination of ferrous iron by permanganate method
7. Determination of Saponification value of oil
8. Determination of manganese from water.
9. Determination of Acidity, Alkalinity

**Practical 1.7 (based on 1.3)**

1. Identification of Minerals and Rocks.
A) Physical properties & chemical composition of various rocks and economic minerals,
B) Hand specimen study of Igneous, sedimentary & metamorphic rocks.
2. Classification of soils, sediment, their texture, mineralogy
3. Basics of mapping - Interpretation of Topo sheets
4. Survey of a given area using GPS survey method
5. Introduction to Google earth, Q GIS
6. Image interpretation of land use/water, vegetation/ lithology
7. Study of geological /contour/drainage pattern maps
8. Determination of pH and Electrical conductivity of soil sample.
9. Determination of moisture content in soil sample

**Practical 1.8 (based on 1.4)**

1. Identification of Common birds
2. Vegetation analysis using quadrats and analysis (Density, frequency, abundance)
3. Vegetation analysis using line / belt transects
4. Assessment of Bird diversity (Transact & point count)
5. Assessing mammal diversity (camera trapping & sign survey)
6. Calculation of diversity index- using any Softwares like Biodiversity pro,
7. Study of forest ecosystem (assessment for forest structure, measurement of GBH, canopy estimation, vegetation analysis, carbon stock and sequestration assessment)
8. Study of Grassland / River /wetland ecosystem (Vegetation mapping, wetland bird analysis)

Study tour for ecosystem assessment, biodiversity studies and conservation.

## 2.1 - Environmental Biotechnology and Microbiology

Credits- 4 Teaching hrs/week = 4 hrs 60 hours

**COURSE OUTCOMES:**

- Develop understanding in microbiology and biotechnology
- Develop understanding in Bioremediation through microorganisms.
- To have a basic idea about microbes in the degradation of wastes.
- To have a basic idea about GMO's and Genetic engineering approaches for waste and environmental pollution management

**Unit -1 - Role of biotechnology in environmental science (15 hrs)**

Introduction to biotechnology, concept of environmental biotechnology, public perception of biotechnology. Applications of some important technologies- Genetic engineering, Genetic concept in environment management, Concept of bio-safety, Fate of GEM'S in the environment, Role of biotechnology in conservation of species.

**Unit- 2 Environmental Microbiology (15 hrs)**

Prokaryotes, classification of microbes, microbial communities in nature, interaction of microbial communities within man, animals and plants, dispersal of microorganisms in different environments, pure culture concept, techniques, preservation and maintenance of microbial culture.

Water microbiology: Waterborne diseases, role of microorganism in treatment of wastewater.

Air microbiology: Aerobiology; allergy; role of microorganism in airborne diseases, Classification and enumeration of microbes in air, dust droplet and droplet nuclei.

Soil microbiology : important microbes for soil fertility, biodegradation; soil borne diseases, Role of microbes in soil reclamation.

**Unit -3 (15 hrs)**

a) Use of biotechnology in innovative practices - Concept of bio-leaching, methods of bioleaching, microorganisms involved, advantages and disadvantages of bioleaching. Concept of bio-absorption, limitations of bio absorption. Concept of bioremediation, microorganisms involved, bioremediation processes and technologies, landfill technologies. Cell immobilization as a tool in waste treatment, Techniques of cell immobilization, Advantages of cell immobilization, Environmental applications of immobilized cells.

b) Use of different technologies

Aerobic Vs anaerobic degradation, testing of biodegradability, Bio-oxidation of phenolic compounds, Bio-degradation of specific hazardous wastes, biodegradation of hydrocarbons.

**Unit 4 (15 hrs)**

a) Biotechnology in agro-industry and forestry

Plant biotechnology, Biological control, Organic farming, Bio-fertilizers - types and production technology, Fermentation technology, Tissue culture, Animal biotechnology,

Applications of biotechnology in forestry, Concept of biofuel, advantages, production. Animal Biotechnology and its application, Vermi-technology.

b) Microbial degradation of chemical pesticides, mechanism of degradation of chemical pesticides and herbicides, concept and types of bio-pesticides and their significance. Application of biotechnology in wastewater treatment - Tanning industry, Distilleries, Dairies, Dye industries, Pulp and paper industry, sugar industry.

References

1. Introduction to Environmental Biotechnology, A. K. Chatterji, Prentice Hall of India Pvt. Ltd, New Delhi
2. Environmental Biotechnology-Basic Concepts and Applications Indu Shekhar, Thakur, I.K. International Pvt. Ltd. New Delhi.
3. Environmental Biotechnology S.K. Agawal, APH Publishing Corp., New Delhi.
4. Elements of Biotechnology, P. K. Gupta, Rastogi Publishing House, New Delhi.
5. Environmental Biotechnology, Jogdand S.N., Himalaya Publishing House, New Delhi.
6. Biotechnology, B.D. Singh, Kalyani Publishers , New Delhi
7. Molecular Biotechnology- Principles and Applications of Recombinant DNA, Glick and Pasternak. Panima Publishing Corporation, New Delhi
8. A Text Book of Biotechnology, R.C. Dubey, S. Chand and Company Ltd., New Delhi.

## 2.2 - Environmental Engineering

Credits- 4 Teaching hrs/week = 4 hrs 60 hours

**COURSE OUTCOMES:**

- Gain knowledge on technology and principles related to reduction of pollutants
- Understand various process and methods involved in treatment of water and waste water
- Describe the function and working of water treatment plants
- Provide Engineering solutions to various environmental problems

**Unit -1 Water & Waste water Treatments (15 hrs)**

Water treatment : Objectives; Physical, chemical and biological properties of water, drinking water Quality standards in India.

Aeration, Sedimentation, Coagulation and flocculation, chemical dosing, jar test; Filtration: mechanism, types of filters(Gravity, pressure, sand filter, dual media filter etc); backwashing. Disinfection: UV, Chlorination, Ozonation. Water softening, Reverse osmosis. Taste, colour and odour removal methods. Activated carbon method, iron and manganese removal, fluoridation and de fluoridation

Primary treatments-principle, flow measurement, screening, grit removal, skimming tank, equalization; sedimentation Secondary treatments- principle, coagulation, flocculation, filtration, chemical precipitation, membrane filtration, activated sludge process, aerobic lagoons, oxidation ponds, septic tank, imhoff tank; trickling filter, rotating biological contactors, Up flow anaerobic sludge blanket (UASB), sludge drying bed, Tertiary treatment - activated carbon,

**Unit – 2 Design and functioning of treatment plants (15 hrs)**

Methods of water treatment, Concept of water treatment plant (WTP), Sewage treatment plant (STP), Effluent treatment plant (ETP), Common Effluent treatment plant (CETP) design aspects of major units in treatment plants and their functions.

**Unit – 3 Air & Noise pollution control (15 hrs)**

a) Air pollution control technologies

Meteorology and plume Dispersion, laws governing behaviour of air pollutants, thermodynamics of major air pollutants, Ambient air quality monitoring, Stack monitoring; Particulate matter control equipment's- Settling chamber, Cyclones, Fabric filter, Electrostatic precipitator, Wet scrubber, Control of gaseous pollutants absorption, adsorption and combustion recovery system, Principle, design and working of catalytic converters.

b) Noise pollution control technologies:

Noise monitoring, noise monitoring devices, ear muffs, silencers, noise absorbers, anti-noise device; Noise control methods

**Unit – 4 (15 hrs)**

a) Municipal, Industrial and biomedical solid wastes and their treatment :

Need of solid waste treatment, dry and wet waste treatments recovery and recycling of metals, disposal methods for medical, industrial and biomedical wastes, Different methods of disposal and management of solid wastes; conversion of solid waste into energy / manure.

b) Innovative techniques for prevention and control of Pollution

Solar detoxification process, Carbon adsorption, Adsorption media filters, Micro screening and other low cost treatment methods, Removal of chromium, phenol, mercury, nitrogen etc. from industrial effluents. Applications of MBBR, MBR.

References:

1. Waste water engineering, Met Calf and Eddy, INC, Tata Mc Graw Hill
2. Indian Standard for Drinking Water, BSI, New Delhi.
3. Environmental Pollution Control, C.S.Rao, Wiley Eastern Ltd.,1993
4. Air Pollution Control and Engineering, De Nevers, Mc Graw Hills, 1993.
5. Fundamentals of Air Pollution, Samuel, J.W., 1971, Addison Wesley Publishing
6. Fundamentals of Environmental Pollution, Krishnan Khannan, S. Chand and Company Ltd.,1994.
7. Noise Pollution, Vandana Pandey, Meerut Publishers,1995.

## 2.3 - Environmental Pollution

Credits- 4 Teaching hrs/week = 4 hrs 60 hours

**COURSE OUTCOMES:**

- Understand the concepts involved in control and prevention of various pollution.
- Understanding the mode of various health effects triggered by air, noise and radiation pollution.
- Demonstrate the various forms of pollution and its impact on different components of the environment.
- Develop expertise in measuring noise level and radiation levels at different sites in different environments.

**Unit – 1 Air & Noise pollution (15 hrs)**

a) Air pollution -natural and anthropogenic sources, Classification of air pollutants, Meteorological aspects of air pollution, types– indoor air pollution, vehicular pollution, industrial pollution; air pollution episodes and disasters, Effects of air pollution on human health, animals, plants, material and climate, Formation of fog and smog, acid rain, Air quality standards, Monitoring of air pollution, Air quality index.

b) Noise Pollution - Concept of noise, Sources, Measurement of noise, Equivalent sound pressure level (Leq), Noise pollution level (NPL), Sound exposure level (SEL), Traffic noise index (TNI), Day-Night level (DNL), Monitoring of noise pollution, Noise exposure levels and standards, Physiological and psychological effects of noise; control of noise.

**Unit – 2 Water Pollution (15 hrs)**

Principal forms of water pollution, sources of water pollution, Water pollution monitoring,, Sampling and physicochemical and bacteriological analysis of water, water quality parameters, Eutrophication, Oil pollution, Ocean pollution-sources of pollution, oil spills, plastics & micro fibres, effects, control.

Ground water pollution - sources of pollution, effects, control, Water quality standards, consequences of water pollution and control. Water quality index.

**Unit – 3 Solid waste & Radiation (15 hrs)**

a) Solid Waste Pollution - Concept and types of solid waste, Effects of solid wastes on environment, Classification of waste–Domestic , Industrial , Municipal, Hospital, Nuclear, Agriculture. Waste minimization technologies, Disposal in landfills, operation of sanitary landfills; leachate and landfill gas management; landfill closure and post-closure environmental monitoring; landfill remediation.

Hazardous wastes: Definition, sources and characteristics: Hazardous waste categorization, generation, collection, transport, treatment and disposal. Legislation on management and handling of municipal solid wastes and hazardous wastes.

b) Radiation Pollution - Types, sources- natural and manmade, fuel processing and radioactive waste, Units of radiations, Measurement and detection of radiation intensity, effects of radioactive pollution, radioactive fallout; control of radiation pollution, Nuclear reactor safety.

**Unit – 4 – Soil & Thermal pollution (15 hrs)**

a) Soil Pollution - Definition; causes of soil pollution; major soil pollutants;, analysis of soil key

parameters, soil acidity, saline and alkaline soil, causes of soil salinity, Chemical and metallic contamination in soil, Mining and soil pollution, physicochemical and biological methods of soil reclamation

b) Thermal pollution: Definition; sources of thermal pollution; effects of thermal pollution; Control of thermal pollution.
Light pollution and its implications.

References:


1. Environmental Pollution Control, C.S. Rao, Wiley Eastern Ltd.,1993
2. Air Pollution Control and Engineering, De Nevers, Mc Graw Hills, 1993
3. Fundamentals of Environmental Pollution, Krishnan Khannan, S.Chand and Company Ltd., 1994.
4. Environmental Chemistry, A. K .De.,New Age Intl. pub Co, New Delhi, 1990.
5. Environmental Pollution Anlysis- Khopkar

## 2.4 OEC - Environment & sustainable development

Credits- 4 Teaching hrs/week = 4 hrs 60 hours

**COURSE OUTCOMES:**

- Evaluation of sustainable development in rural and urban environment
- Understand Impact of urbanization Environment
- Assessment of suitability of land for sustainable use
- Understand the role of NGO's in sustainable management of resources

**Unit -1**

**a) Introduction to Environmental Science: (15 hrs)**

Meaning, scope and interdisciplinary nature of Environmental Science, Environmental Science and technology, Media and people, decision making and applications of Environmental Science.

**b) Environmental ethics:**

Nature and origin of environmental ethics, ecological consciousness, western and Eastern views, philosophy of environment, Environment, community and equity, Integrating ethical values and knowledge, self centered development and environment.

**Unit- 2 Global and national environmental issues: (15 hrs)**

Greenhouse effect, Acid rain, Global Warming, Ozone depletion, Climate change, Carbon Sequestration, Clean Development Mechanism, Climate change, Carbon credits, Carbon footprint, Deforestation, Biodiversity loss, Desertification**. policy implementation and its impact on the local communities**

**Unit -3 Human impact on environment and its consequences (15 hrs)**

Hunting and gathering, agriculture societies, Human history Rise and Fall of civilisations, Age of colonisation, industrial societies, impact of cultural change on environment, population explosion, degradation of natural resources, pollution of air, water and soil, urbanization, industrialization, food security, public Health, energy crises, present status of environment and future scenarios.

**Unit – 4 (15 HOURS)**

**Sustainable Development** – scope & definition, parameters of sustainability, Concept of eco-development Vs growth, Concept of eco-development, Integrating economic and ecological principles, definition of physical, economic and ecological growth, cost benefit ratios, development processes and growth, Integrated approach to environment and development, Western Ghats eco-development plan, developmental models for hilly area, river basins lands, growth centres. environmental education and awareness.

References –


1. Environmental Science - Arms Karen
2. Principles of Environmental Science-Watt, K. E. F. (1973) McGraw-Hill Book Company.
3. Environmental Science –Noble, B .J. Kormandy, E.J.(1981),The way world works, Prentice-Hall Inc., N .J.
4. Environmental Science-Turk A. , Turk J. Wittes J.T. and Wittes, R.E.
5. Environmental Issues: Measuring, Analyzing, Evaluating, Abel, Daniel C. McConnell, Robert L. Abel, Daniel C. Edi. 2 Prentice Hall Publication
6. Botkin Daniel. B and Edward. A. Keller, Environment Science – Earth as a living Planet, John Wiley and Sons, 2005.
7. Miller, G., Spoolman, S., 2007. Environmental Science: Problems, Connections and Solutions. Cengage Learning.
8. V. P. Agrawal. (1968). Forests in India: Oxford & IBH Publishing Co. Pvt.Ltd. New Delhi.
9. Sitram Rao. Introduction to Social Forestry, Oxford and IBH Pub. Co. Pvt. Ltd.
10. Anand S. Bal. (2005). An Introduction to Environmental Management, Himalaya Publishing House.
11. Prabhakar V.K. Energy Resources and Environment, Anmol Publisher
12. Rai G.D. Non Conventional Energy Sources, Khanna Publication, New Delhi.
13. Kothari D.B and Singal K.C. (2011). Renewable Energy Sources and Emerging Technologies: PHI Learning Pvt. Ltd. New Delhi.
14. Satyanaraya, Sitre S.R, Zade S.B, Meshram P.U. A Textbook of Environmental Studies: Allied Publisher.
15. Oliver S. Owen. (1980). Natural resources conservation – An Ecological approach, 3rd edition, Macmillan publishing Co. Inc. New York.
16. Daniel D. Chiras. (1994). Environmental Science. 4th edition.
17. Sapru R.K. (1987). Environment Management in India. Vol. I & II. Ashish Pub. House.
18. Agarwal and Rana S.V.S. (1985). Environment & Natural resources, society of Biosciences.
19. Sharma V.K. (1985). Water resources planning and management, Himalaya Pub. House.
20. Francois Ramade 1984.Ecology of Natural Resources. John Wiley & Sons Ltd.
21. Harris, J.M. 2006. Environmental and Natural Resource Economics: A Contemporary Approach, 2nd edition. Houghton Mifflin.
22. Coastal Ecology & Management, Mann, K.H. 2000. Ecology of Coastal Waters with Implications for Management (2nd Edition).Chap. 2-5, pp.18-78 & Chap. 16, pp.280-303.
23. Global Change and Natural Resource Management, Vitousek, P.M. 1994. Beyond global warming: Ecology and global change. Ecology 75, 1861-1876.
24. Agarwal, K.C., 2001. Environmental Biology, Nidhi Publication Ltd. Bikaner.
25. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001,Environmental Encyclopedia, Jaico Publishing House.
26. Heywood, V.H. & Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press.
27. Miller T.G.Jr. Environmental Science, Wadsworth Publishing Co. (TB)
28. Townsend C., Harper J, and Michael Begon. Essentials of Ecology, Blackwell Science.
29. Barber, E. 1989. Economics: Natural Resources Scarcity and Development. Earthscan.
30. Kamaljit S. B., et. Al., 2011, Conservation Biology, Universities Press.

## 2.5 Education for sustainable development

**Soft core - Credits -2 , Hours of Instruction - 2hrs/Week, 30 hrs/semester**

### COURSE OUTCOMES:

- Develop understanding towards education for sustainability
- Use of various education pedagogy
- To Understand designing of education modules
- Evaluation and development of curriculum for sustainable development

**Unit 1 - 10 hours**

Introduction to ESD - History of Environment Education, Indian Perspective, Emergence of the concepts of ESD, Inter linkages of ESD and sustainable development, ESD and Sustainability-transdisciplinary approach.

Nature and Objectives of Primary, Secondary and Higher Education in India. National Curriculum Frame work for School Education, Indigenous knowledge, traditional knowledge.

**Unit 2 - 10 hours**

Recent techniques in education. Definition, Objectives, Principles of - Team Teaching, Collaborative Learning, experiential learning, Online, Social media, campaigns. Diverse education modules – posters/ brochures/ documentaries/ theatre/ games/ other media etc.
Education and Human Resource Development - Ways of Developing Human Resources; Indicators of Human Development; Education for Twenty First century

**Unit 3 - 10 hours**

Introduction to systems thinking, Systems landscape, Whole institutional approach, Greening Curriculum : Need, challenges and practices.
ESD : Meaning, Nature, Scope, Approaches and strategies ,Integration in Curriculum, Role of Teacher in promoting sustainable development.
Traditional and transformative learning pedagogy; Constructivism, Inquiry based, reflective, collaborative, integrative.

**Reference books**


1. An Introduction to Sustainable Development-Peter P. Rogers, Kazi F. Jalal, and John A. Boyd
2. Understanding Sustainable Development-John Belwitt
3. Limits to Growth – The 30 year update by Donella Meadows, Dennis Meadows, Jorgen Randers
4. Cradle to Cradle Remaking the Way We Make Things by William McDonough and Michael Braungart North Point Press
5. Our Common Future -World Commission on Environment and Development Oxford paperbacks
6. Education for Sustainable Development: Nature, School and Democracy Illustrated Paperback-by KlasSandell,JohanOhman and Leif Ostman
7. Sustainable Education: Revisioning Learning and Change (Schumacher Briefings) [Paperback] by David ORR and S.R.Sterling
8. Thinking in Systems: A Primer [Paperback] Donella H.Meadows


**Suggested Readings**


1. Small is Beautiful- Economics as if people mattered by EF Schumacher
2. At the edge –Ann Dale UBC press
3. Collapse – How societies choose to fail or succeed by Jared Diamond Penguin publishers
4. Development as Freedom – Amartya Sen –Publisher Anchor
5. Resilience Thinking-Sustaining ecosystems and people in a changing world by Brain Walker and David Salt
6. Leadership for Sustainability –an action approach by Judi Marshall, Gill Coleman and Peter

**Practical - Semester II**

**Practical 2.6 (based on 2.1)**

1. Methods of collection preservation in microbiological studies
2. Serial dilution of soil and water
3. Preparation of different types of microbial culture media
4. Study of microorganisms in air
5. Study the morphology of the organisms by monochrome/negative/gram staining
6. Study of isolation of bacteria by Streak plate/Spread Plate/ Pour Plate method.
7. Isolation, enumeration and identification of microorganisms in soil samples
8. MPN techniques for coli form analysis

**Practical 2.7 (based on 2.2)**

1. Determination of DO in water
2. Determination of BOD
3. Determination of COD
4. Estimation of hardness
5. Estimation of Total dissolved solids and Total suspended solids & Total Solids
6. Determination of turbidity and optimum alum dose by jar test.
7. Determination of fluorides in given water sample.
8. Determination of chlorine demand and residual chlorine for potable water.
9. Determination of phosphates in water / wastewater sample.
10. Determination of sulphates in water / wastewater sample.
11. Determination of oil and grease in wastewater

**Practical 2.8 (based on 2.3)**

1. Determination of Organic carbon in soil
2. Determination of Nitrite/Nitrate/Total nitrogen/Ammonia nitrogen in water and soil samples.
3. Determination of sodium and potassium by flame photometry
4. Determination of pesticides by Gas chromatographic method.
5. Estimation of Suspended Particulate Matter (SPM) and Respirable Particulate Matter (RPM) using high volume sampler.( PM10 and PM2.5)
6. Estimation of SOx and NOx in ambient air (including sampling).
7. Monitoring of wind speed and wind direction using anemometer and construction of wind rose.
8. Measurement of ambient noise in different environments by sound level meter (SLM)
9. Determination of Sludge Volume Index and Mixed Liquor Suspended Solids.
10. Basic radioactive measurement procedures/ Radiation estimation using dosimeter

Visit to water / wastewater treatment plants /Air sampling station/
Field visit to assess air and noise pollution.