

No.AC.2(S)/785/2019-20

Vishwavidyanilaya Karyasoudha,  
Crawford Hall, Mysore-570 005.  
Dated: 12.07.2019.

**NOTIFICATION**

**Sub:** Minor modifications in the existing syllabus of M.Sc. Environmental Science from the Academic Year 2019-20.

- Ref:** 1. Decision of Board of Studies in Environmental Science (CB) meeting held on 15.12.2018.  
2. Decision of the Faculty of Science & Technology Meeting held on 01.04.2019.  
3. Decision of the Academic Council meeting held on 07.06.2019.

\*\*\*\*\*

The Board of Studies in Environmental Science (CB) which met on 15.12.2018 has recommended to make minor changes to the existing syllabus of **M.Sc. Environmental Science** from the Academic Year 2019-20.

The Faculty of Science and Technology and Academic Council meeting held on 01.04.2019 and 07.06.2019 respectively have approved the above said proposal and the same is hereby notified.

The modified syllabus of M.Sc. Environmental Science course is annexed. The contents may be downloaded from the University Website i.e., [www.uni-mysore.ac.in](http://www.uni-mysore.ac.in).

Draft approved by the Registrar

Sd/-  
**Deputy Registrar (Academic),**

**To:**

1. The Registrar (Evaluation), University of Mysore, Mysore.
2. The Dean, Faculty of Science & Technology, DOS in Zoology, Manasagangotri, Mysore.
3. The Chairperson, BOS in Environmental Science, DOS in Environmental Science, Manasagangotri, Mysore.
4. The Chairperson, Department of Studies in Environmental Science, Manasagangotri, Mysore.
5. The Director, College Development Council, Moulya Bhavan, Manasagangotri, Mysore.
6. The Deputy/Assistant Registrar/Superintendent, AB and EB, UOM, Mysore.
7. The P.A. to the Vice-Chancellor/Registrar/Registrar (Evaluation), UOM, Mysore.
8. Office file.

2019-2020

**UNIVERSITY OF MYSORE**  
**DOS IN ENVIRONMENTAL SCIENCE**  
**MANASAGANGOTRI, MYSORE-6**

**Choice Based Credit System of Syllabus**  
**Master's Degree Programme in Environmental Science**

**I Semester**

Sl.No.	Paper code	Title of the Paper	HC/SC/OE	L T P	Total Credits
1		Environmental Chemistry	HC-1	2 1 1	4
2		Environmental Geology	HC-2	2 1 1	4
3		Environmental Microbiology	HC-3	2 1 1	4
4		<b>Any two papers</b> Energy and Green Technologies	SC-1	2 1 1	4
5		Environmental Statistics	SC-2	2 1 1	4
6		Environmental Education and Awareness	SC-3	3 1 0	4

**Total 20 Credits**

**II Semester**

No.	Paper code	Title of the Paper	HC/SC/OE	L T P	Total credits
1		Water and Wastewater Management	HC-4	2 1 1	4
2		Occupational Health Hazards	HC-5	2 1 1	4
3		Advanced Instrumentation	HC-6	2 1 1	4
4 & 5		<b>Any one of the papers</b> Environmental Biotechnology	SC-4	2 1 1	4
		<b>Or</b> Remote Sensing and GIS	SC-5	2 1 1	4
6		<b>Open Elective *</b>			4

**Total Credits 20**

**III Semester**

No.	Paper code	Title of the Paper	HC/SC/OE	L T P	Total credits
1		Environmental Biology	HC-7	2 1 1	4
2		Air, Noise and Radiation Pollution	HC-8	2 1 1	4
3		Disaster Management	HC-9	3 1 0	4
4		<b>Any one of the Papers</b> EIA, Environmental Policy and Laws	SC-6	3 1 0	4
		<b>OR</b> Climate Change and Current Issues			4
5			SC-7	3 1 0	
6		<b>Open Elective *</b>			4

**Total Credits 20**

### IV Semester

No.	Paper code	Title of the Paper	HC/SC/OE	L T P	Total credits
1		Conservation of Biodiversity	HC-10	2 1 1	4
2		Solid Waste Management	HC-11	2 1 1	4
3		Major Project work	HC-12	0 1 3	4
4 & 5		<b>Any one of the papers</b> Environmental Toxicology	SC-8	2 1 1	4
		Marine Ecology and Coastal Pollution	SC-9	2 1 1	4
6		<b>Open Elective *</b>			4

**Total Credits 20**

**Open Elective Papers\***

Sl.No.	Paper Code	Title of the Paper	HC/SC/OE	L T P	Total Credits
1		Environment and Health	OE-1	3 1 0	4
2		Ecotourism and Wild life Management	OE-2	3 1 0	4
3		Environmental Pollution and Management	OE-3	3 1 0	4
4		Environmental Planning & Sustainable development	OE-4	3 1 0	4
5		Nuclear & Bio Medical Waste Management	OE-5	3 1 0	4
6		Ecology & Environment	OE-6	3 1 0	4

\*

**Courses will be offered in II, III & IV Semesters as will be decided in department council.**

**I\*, II, III and IV Semesters:**

Hard Core papers -	48 Credits
Soft Core Papers -	20 Credits
Open Elective Papers -	12 Credits
<b>Total</b>	<b>80 Credits</b>

**\* There is no Open Elective Paper for first Semester**

**UNIVERSITY OF MYSORE  
DOS IN ENVIRONMENTAL SCIENCE, MANASAGANGOTRI, MYSORE-6**

**Choice Based Credit System of Syllabus  
Master's Degree Programme in Environmental Science  
I Semester**

**1. Environmental Chemistry (Hard Core):**

**Unit 1 – Fundamentals of Environmental Chemistry:** Stoichiometry, Gibbs' energy, Chemical potential, chemical equilibria, acid-base reactions, solubility product, solubility of gases in water, the carbonate system, unsaturated and saturated hydrocarbons, radionuclides.

**Unit 2 – Atmospheric chemistry:** Chemical composition of Air: Classification of elements, chemical speciation. Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matters. Thermo chemical and photochemical reactions in the atmosphere. CFC's, Oxygen and Ozone chemistry, chemistry of air pollutants, photochemical smog.

**Unit 3 - Chemical pollution and fundamentals of chemical reactions:** Oxidation, reduction, precipitation. Toxic chemicals in the environment, biochemical aspects of Arsenic, Cadmium, Lead, Mercury CO, O<sub>3</sub>, PAN, pesticides, MIC and carcinogens in air.

**Unit 4. Water chemistry:** properties of water, water pollutants- sources & types - heavy metals- metalloids, types of reactions in various water bodies including marine environment. Chemistry of oil based and water based paints, physico-chemical basis of redox processes. Electrochemical theory of corrosion.

### **Practicals :**

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 total dissolved solids in water samples.
4. Determination of Carbonates and Bicarbonates in water samples
5. Determination of Chloride in water sample by AgNO<sub>3</sub> method
6. Estimation of Iodine value of given oil sample by C.A.T method
7. Determination of copper content in industrial effluents by Iodometric method
8. Determination of ferrous iron by permanganate method
9. Estimation of the amount of phenol/ Aniline in the water sample by Bromate- Bromide method
10. Determination of Saponification value of given oil samples.

### **References:**

1. Analytical Chemistry of Industrial poisons, Hazards and solvents by Jacobs M.B. Inter Science. New York, (1969)
2. Environmental Chemistry, Sharma B.K. & Kaur, Goel Publishing House Meerut, (1995)
3. Chemistry for Environmental Engineering, Sawyer C.N, Mc Marty P.L. and Perkin G.F. Mc Graw Hill, (II ed) (1994)
4. Environmental Chemistry, Tyagi O.D. and Mehra M Anmol Publications, (1990)
5. Environmental Chemistry, Manahan S.E, Lewis Publications, Florida, U.S.A, (7<sup>th</sup> ed), (2000)
6. Chemistry of the Environment, Bailey R.A. Academic Press, , (1970)
7. Vogel's Text book of quantitative Inorganic analysis Bernetts.J, Denney.R.C., Jeffery.J.H. and Mendham.J

## **2. Environmental Geology (Hard Core):**

**Unit 1 – Environmental Geology – objectives, scope and necessity, Origin of the Earth, Earth systems and its interaction with - lithosphere, atmosphere, hydrosphere and biosphere, Interior of the Earth, Earth's Materials – Minerals and their definition. Distribution and abundance of elements in the Earth's crust, Formation and classification of Rocks. Soil-characteristics, formation of soil, erosion and conservation.**

**Unit 2 – Earth's Processes – Endogenic and Exogenic processes: Earthquakes, Tsunami and Volcanism. Geological agents: River, Wind, Glaciers and Ocean action. Floods,**

landslides, cyclone and avalanche, Concepts of major, trace and REE, Classification of trace elements, Mobility of trace elements, Geochemical cycles. Human use of trace elements and health.

**Unit 3** – Mineral resources and environment. Resources and reserves, Depletion trends of natural resources. Environmental impact of exploitation, Land use Planning- Environmental aspects of terrain evolution, Methods of site selection and evaluation of land in environmental planning. Geological features of India and Karnataka.

### **Practicals :**

1. Identification of Minerals and Rocks.
  - a) Physical properties & chemical composition of various rock forming and economic minerals,
  - b) Hand specimen study of Igneous, sedimentary & metamorphic rocks.
2. Classification of soils, sediment their texture, mineralogy
3. Interpretation of Toposheets

### **References:**

1. Earth Science and the Environment, Richard J.Ordway, D.Van Nostrand and Company, London.
2. Encounter with the Earth, L.F. Oxford press, San Francisco., Laporte,
3. Soil and water conservation Engineering, Schwab. S.O, Frevert.R.K, Edimster. T.W. and Barns, K.K., John Wiley and Sons, 1975.
4. Land Application of Wastes, Loehr, R.C.Jesel, W.J.Novak, N.D., Clarkson, W.S. and Friedeman G.S., Van Nostrand Reinhold Co., New. York., Vol-I and II, 1979
5. Environmental Geology, Valdia K.S., 1987
6. The nature of Oceanic life, Menard H.W., W.H.Freeman and Company, San Francisco, The Ocean – A Scientific American Book, (1969).
7. Essentials of Geology, Reed Wicander & James S. Monroe, Wadsworth publishing company, (2002).

## **3. Environmental Microbiology (Hard Core):**

**Unit – 1:** Introduction, Concepts and scope of environmental microorganisms as components of ecosystem, Classification and characteristics of Microorganisms, Microbial interactions. Micro organisms as bio-indicators in the environment, Role of microorganisms in CNS cycles.

**Unit 2:** Microbial diversity of environment: Microbes in air, water, waste water and soil; Introduction, distribution, sampling techniques and identification. Microbes of extreme environment. Mechanisms of adaptation by microorganisms to environmental extremes, Indicator organisms in waters, Ecological implication of genetically modified microorganisms.

**Unit – 3:** Microbes in the degradation of wastes, Bioremediation-Its role in Environmental management, advantages and disadvantages. Control of pests and diseases by microorganisms, Treatment of solid and liquid industrial wastes, Microbial degradation of pesticides. Microbes in metal extraction, mineral leaching and mining, copper extraction by leaching and microbes in petroleum product formation.

**Practicals:**

1. Methods of collection preservation for microbiological studies
2. Serial dilution of soil and water
3. Preparation of different types of microbial culture media
4. Gram staining techniques
5. Study of microorganisms in air
6. Isolation, enumeration and identification of microorganisms in soil samples
7. MPN techniques for coli form analysis
8. Effect of heavy metals on microbial growth
9. Effect of pesticide on soil microorganisms

**References:**

1. Environmental Microbiology Principles and Applications. Patrick K. Jemba.
2. Environmental Microbiology By. P D Sharma
3. Environmental bioremediation technologies. Shree N. Singh,  
Rudra D. Tripathi
4. Introduction to Microbiology. A. S. Rao
5. Microbiological examination of water and wastewater, Maria Csuros,  
Csaba Csuros.
6. Environmental Microbiology. Raina M. Maier, Ian L. Pepper, Charles  
P. Gerba - Science.
7. Text book of Environmental, Microbiology, Mohapatra - Technology  
& Engineering.

**Any Two Papers: (out of papers 4 5 & 6)**

**4. Energy and Green Technologies (Soft Core):**

**Unit 1** - Introduction – renewable energy sources, non-renewable energy sources, non-conventional and inexhaustible energy resources. Geothermal energy, wind driven power station, Tidal power plants, Glacier power plants, solar energy, nuclear energy, natural radio activity, nuclear power plant, fast breeder reactors, nuclear fusion, gober gas

**Unit 2** – Energy management – solar energy input, conventional fuels – oil, coal, natural gas, uranium, risk of nuclear accidents, bio energy – biomass and biofuels, biogas- biogas technology, petroplants, energy plantations and crops. Waste as renewable sources of energy- types of wastes, classification based on chemical nature and physical state, composition of the waste, conversion of methane into synthetic gas, factors affecting methane formation.

**Unit 3** – Green Technology: Phytoremediation- Hyperaccumulators- biotic interactions, biofilm, Green chemistry- introduction- inception and evolution- importance of solvents- types of catalysts and their role- Biological alternatives- applications. Principles of green chemistry, advances in green chemistry.

### **Practicals :**

1. Study and identification of energy plants
2. Adsorption and removal of chromium using different biomaterial
3. Adsorption and removal of iron using biomaterials
4. Study of biofuel /green chemistry / petroleum energy plants characteristics.
5. To study the working principles of wind plant/ nuclear energy plant / Gobar gas plant/Glacier plant

## **5. Environmental Statistics (Soft Core):**

**Unit 1-Sampling-** Types of sampling, **Descriptive Statistics**, Descriptive vs. Inferential, Measures of location — mean, median, mode, Measures of dispersion — variance, standard deviation, range and interpercentile ranges Dispersion Percentages, Skewness, Concepts of outliers, **Correlation and regression**-Bi-variate data and scatter diagram, Simple (linear) correlation and regression, Coefficient of correlation and regression and their properties, Fitting of regression line, Multiple and partial correlations and regressions. **Graphs and Displays**-Introduction, z-Scores and Percentile Ranks, Stem and Leaf Displays,

**Unit 2- Matrices and determinants-** Types of matrices, addition and subtraction of matrices, Multiplication of a matrix by a scalar, Products of matrices, Evaluation of  $2 \times 2$  determinants, Inverse of  $2 \times 2$  matrices, Combinations of transformations, Eigen value, Applications of matrices in Environmental Impact assessment.

**Unit 3- Probability-** Introduction, Random Variables, Definition, Expected Value, and Standard Deviation, Probability Distributions, Binomial and Poisson Distributions, **Statistical hypothesis testing**-The basic approach, Alternative hypothesis, Examples of bad practice, **One sample tests in environmental science-** Z-test on a mean with known variance, T-test on a mean with unknown variance, Z-test for non-zero correlation, **Two**

**sample tests-** T-test on unpaired means with unknown variance, T-test on paired means with unknown variance, F-test for equal variances, Z-test for unpaired equal correlations, Chi Square test, ANOVA,

**Unit 4-** Introduction to environmental system analysis; Approaches to development of models; linear simple and multiple regression models, validation and forecasting, operating system, DOS, UNIX, LINEX, M.S. Office, Computer applications in



Environmental Sciences, point source stream pollution, model, box model, Gaussian plume model, General Circulation Model(GCM) for climatic change.

**Practicals based on the above theory units.**

**References**

1. Fundamentals of Mathematical Statistics by S. C. Gupta and V. K. Kapoor; S. Chand & Co.
2. Statistical Methods in Geographical Studies, by Aslam Mahmood, Rajesh Publications, New Delhi
3. Statistical Methods: An Introductory Text by J. Medhi, New Age International Ltd. Publishers
4. Practical Statistics (Vol 1&2) by Singh, Atlantic Publishers
5. Environmental Statistics and data analysis, Ott, W. R., Lewis Publishers, New Jersey.
6. Statistical Methods, G. W. Snedecor & W. G. Cochran.
7. Statistics for environmental Biology and Toxicology, W. W. Piegorsh & A. J. Bailer.

**6. Environmental Education and Awareness (Soft Core):**

**Unit 1** – Introduction, scope, knowledge about environment, environmental relationship and population growth, knowledge about solution and prevention of environmental problems rational uses of resources.

**Unit 2** – Goals and objectives of environmental education, PAP (Public awareness programme) strategies for environmental education - authorization, curriculum manual teaching methods and evaluations of environmental education.

**Unit 3** – Environmental movements – global national environmental movements, major environmental movements in India, Chipko, silent Valley movement, Appiko movement, Narmada Bachao Andolana, Tehri dam conflict.

**Unit 4** – Environmental conferences – important goals and achievements. International agreements – United Nations conventions on climate change, earth summit, Copenhagen summit.

**References :**

1. Kumar, Environmental Awareness, Jain Books & Periodicals New Delhi (2008)
2. Behera, Basic Environmental Education, super Book Service, Bangalore.
3. Nanda A.N., Environmental Education, (1996).
4. Mohanka R, Environmental Education Vol. 1 & 2 Agrosiences centre, New Delhi.
5. Environmental Education for Sustainable Development, by Deshbandu et.al., India Environmental Society, New Delhi, 1995
6. Documents in the Environmental Education Series, a series of 22 volumes brought out by UNESCO on various aspects of Environmental Education.
7. Essential Learnings in Environmental Education, A Handbook of Environmental concepts, brought out by Centre for Environment Education, Ahmedabad, 1991.

## II SEMESTER

### **1. Water and Wastewater Management (Hard Core):**

**UNIT-1 :** Hydrology, Sources of water and its characteristics, Distribution of water on Earth. Physical and Chemical properties of Water, Various types of water demands, per capita demand water quality standards for various uses. Water Pollution, Water quality standards for various uses, parameters, sources and types of Pollution, pollution scenario of Indian Rivers, water harvesting and watershed management.

**UNIT – 2:** Ground water Hydrology, Occurrence of groundwater, Ground water zones, and Groundwater System. porosity, permeability and types of Aquifers. The Water Table, ground water flow, functions and Topography, Ground water depletion, Ground water Quality, Ground water pollution, Saltwater Intrusion, Changes in Ground water Quality.

**Unit 3–** Water purification-Screening – Treatment system- sedimentation, coagulation, filtration – rapid sand filter, slow sand filter, advantages and disadvantages. Disinfections – Methods of disinfections, water softening process, taste and odor removal (Aeration).

Wastewater treatment: Characteristics of wastewater, Screening & Grit chambers primary treatment – sedimentation and flocculation, equalization, neutralization, secondary treatment – Aerated lagoons, Trickling Filters, Activated Sludge process, Oxidation pond, Aerobic and Anaerobic decomposition of wastewater, Tertiary treatment, sludge drying beds.

#### **Practicals :**

1. Determination of DO in water and wastewater samples
2. Determination of BOD
3. Determination of COD
4. Determination of porosity and permeability of different soils.
5. Determination of infiltration and runoff characteristics.
6. Determination of nitrite content of water samples
7. Determination of phosphate content of water samples
8. Visit to water & wastewater treatment plants

#### **Reference :**

1. Water and waste water Engineering, Vol.I and II, Fair, G.M. Geyer T.C. and Okun. D.A. (1984): John Wiley and Sons, Strauss, (1975) & (1984)
2. Waste water treatment processes, Metcalf and Eddy Inc. Academic Press, New York. (1979)
3. Standard Methods for Examination of Water and Waste Water American Public Health Association (5<sup>th</sup> Ed) (1980)
4. Waste Water Engineering, Metcalf and Eddy Tata Mc Graw Hill,
5. Physico – Chemical Process for Water quality, Weber. W.J, Ann Arbor. and company, New Delhi (1974)
6. Water and waste Engineering, Vol.I and II, Fair, G.M. Geyer T.C. and Okun. D.A. (1984): John Wiley and Sons, Strauss, (1975) & (1984)
7. Waste water treatment processes, Metcalf and Eddy Inc. Academic Press, New York. (1979)
8. Standard Methods for Examination of Water and Waste Water American Public Health Association (5<sup>th</sup> Ed) (1980)

9. Waste Water Engineering, Metcalf and Eddy Tata Mc Graw Hill,
10. Physico – Chemical Process for Water quality, Weber. W.J, Ann Arbor.

## **2. Occupational Health Hazards (Hard Core):**

**Unit – 1** Occupational Environment- Physical, Chemical, Biological agents. Occupational hazards- Physical hazards, chemical hazards, Biological hazards. Occupational diseases- Pneumoconiosis- silicosis, Anthracosis, Byssinosis, Bagassosis, Astertosis, Farmers lung, Lead poisoning, Occupational cancer, Occupational Dermatitis, Radiation hazards.

**Unit - 2** Occupational hazards of agricultural workers- somatic diseases, accidents, toxic hazards, physical hazards, respiratory diseases, accidents in industry, sickness, absenteeism, health problems due to industrialization.

**Unit - 3** Measures for health protection of workers, preservation of occupational diseases- medical measures, engineering measures, Legislation- The factories Act, 1948. Human health problems due to pollution, public health programs , food poisoning- types of food poisoning prevention and control, indicators of health.

### **Practicals :**

1. Study of Byssinosis
2. Study of bagassosis and
3. Study of pneumoconiosis
4. Documentation of Allergic diseases and causes
5. Safety devices in industries
6. Survey and documentation of occupational diseases and causes in given areas
7. Respiration disorder in industrial workers.
8. Occupational health hazards in agricultural workers.

### **References :**

1. Fundamental principles of occupational health and safety. Benjamin O. Alli Handbook of Occupational Safety and Health, Louis J. Diberardinis,
2. Environmental Hazards: Assessing Risk and Reducing Disaster, Keith Smith, David N. Petley.
3. Physical and Biological Hazards of the work place, Peter H. Wald, Gregg M. Stave Proctor and Hughes.,
4. Chemical Hazards of the Workplace. Gloria J. Hathaway, Nick H. Proctor, James P. Hughes.,
5. Implementation of occupational health legislation at work place, issues and concerns. G. K. Kulakarni.,
6. Disaster Management future challenges and Opportunities by Jagbir Sing, I.K. International.

## **3. Advanced Instrumentation (Hard Core):**

**Unit 1** - Optical methods: Various ranges of electromagnetic radiations, interaction of electromagnetic radiation with matter, UV-Visible spectroscopy: Theory, instrumentation and applications to environmental samples, optical fibers in spectroscopy. X-ray fluorescence, X-ray diffraction.

**Unit 2** – IR and NDIR spectroscopy: Molecular vibrations and vibration frequencies, special features of IR and NDIR instruments. Applications for the environmental samples.

Continuous monitoring of CO using NDIR spectroscopy, Atomic Absorption Spectrophotometer, principles, instrumentation and applications in environmental sample analysis. Atomic Emission Spectroscopy-Principle, instrumentation and applications of flame emission spectroscopy.

**Unit 3** – Nephelometry and turbidimetry: Principles and applications in the determination of turbidity of water. Thermo quality Radio analytical methods: Radiochemical techniques- Principles and applications of neutron activation analysis and isotope dilution analysis. Polarography: Principles, instrumentation and applications of polarography in the environmental sample analysis. Solvent extraction, thin layer chromatography, gas chromatography, HPLC and Ion exchange chromatography.

### **Practicals :**

1. Spectrophotometric determination of trace elements
2. Conductometric titration of water & Soil extract samples.
3. Extraction of plant pigments and study of TLC and column chromatography
4. Determination of Fluorides by spectrophotometry
5. Determination of Organic carbon in soil by titrimetric and spectrophotometric methods
6. Potentiometric titration of Non-aqueous solvents.
7. Determination of Nitrite/Nitrate/Total nitrogen/Ammonia nitrogen in water and soil samples.
8. Determination of sodium and potassium by flame photometry
9. Determination of pesticides by Gas chromatographic method.
10. Determination of phosphate by Molybdate method
11. Determination of SO<sub>2</sub> in air sample by para-rosaniline method

### **References :**

1. Basic concepts of Analytical Chemistry – S.M.Khopkar, 2<sup>nd</sup> edition New Age International Pub (1998)
2. Environmental Pollution analysis, S.M.Khopkar, Wiley Eastern Ltd. (1993)
3. Analytical Chemistry – G.D.Christian, 5<sup>th</sup> edition, John Wiley and sons Inc., India (2001)
4. Principles of Instrumental analysis – D.A.Skoog, F.J.Holler and T.A.Nieman 5<sup>th</sup> edition Thomson Asia Pvt., Singapore, (1980)
5. Quantitative analysis, - A.I. Vogel, 6<sup>th</sup> edition, Prentice Hall Inc., (1998)
6. Introduction to Chemical Instrumentation – Bour.E.J. Wiley and sons 4<sup>th</sup> edition (1982)
7. Instrumental Methods of Analysis – Willard.H.H., Merrit.L.L. and Dean.J.A – Van Nostrand Reinhold, 5<sup>th</sup> edition (1976)
8. Environmental Chemistry – Manahan.S.E.7<sup>th</sup> edition Lewis Publications, Florida, USA

### **Any One Paper: (out of papers 4 & 5)**

#### **4. Environmental Biotechnology (Soft Core):**

**Unit – 1:** Biotechnology and Biodiversity: conservation and utilization methods, their merits and demerits. Role of Biotechnology in energy production and management. Biosensors - Response of Biosensors, Types of biosensors, Application of Biosensors. Advantages of micro biosensors. Biochips – Biosurfactants,

**Unit – 2:** Biotechnological approaches for the degradation of petrochemical, tannery, industrial wastes, natural dyes, synthetic dyes, semisolid sludge, paper and distillery effluents. Technologies for environmental monitoring with special reference to prevention and detection. Concept of GMO's and genetic engineering approaches to waste treatment and environmental pollution management.

**UNIT–3:** Biotreatment of waste, Biofilters-types and applications. Bio fertilizer, importance and classification. Vermitechnology-vermicomposting and vermiculture. Role of biotic and abiotic factors in production of vermicompost. Organic farming and its applications. Microbial cellulolytic degradation of organic waste.

### **Practicals :**

1. Determination of anti oxidant capacity by phosphomolybdate method.
2. Study of biomass in polluted soil and water.
3. Determination of catalase activity in a water sample.
4. Study of cellulolytic degradation of organic waste.
5. Determination of sulphates in a given sample.
6. Determination of phosphates in a given sample.
7. Extraction of DNA from a tissue (mammalian liver/fish liver).
8. Extraction of RNA from plant/animal sources

### **Reference:**

1. Text book of Environmental Biotechnology by Pradipta Kumar Mohapatra
2. Text book of Environmental Biotechnology by Indu Shekhar Thakur
3. Text book of Biotechnology by R.C. Dubey
4. Text book of Environmental Biotechnology by B.D.Singh
5. Text book of Environmental Chemistry by Ajay Kumar Bhagi & G.R.Chatwal
6. Text book of Microbiology by Pelzar

## **5. Remote Sensing and GIS (Soft Core):**

**Unit 1** - Fundamentals of Remote sensing: Remote Sensing – history & development, definition, concept and principles, Energy Resources, radiation principles, Electromagnetic radiation, Interaction between matter and Electromagnetic radiation, Sensors: Types of sensors, Concept of Resolution – Spatial, Spectral, Temporal , Radiometric, Basic concepts and principles of Thermal , microwave and hyper spectral sensing, Spectral reflectance and their characteristics of Earth surface features,

**Unit 2** - Platforms –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 equipments- digital image processing- image rectification, enhancement, classification, data merging and biophysical modeling- image processing software. Satellites and their characteristics – Geo-stationary and sun-synchronous, Indian Space programme

**Unit 3** - Introduction to GIS: GIS and their uses for Environmental monitoring, Remote Sensing Data Products and their procurement, GIS and spatial distribution of environmental data, Data integration

and analysis, Data based structure, satellite data analysis, GIS software. Remote sensing and GIS applications - Management and monitoring of Environment, conservation of resources, natural resources , coastal zone management.

### **Practicals :**

1. Survey of a given area using Chain survey method
2. Survey of a given area using Plane table survey method
3. Survey of a given area using Compass survey method
4. Survey of a given area using GPS survey method
5. Image interpretation of land use/water, vegetation and lithology
6. Study of geological /contour/drainage pattern maps
7. Assessment of pollution status of the given map

### **Reference :**

1. Environmental Radioactivity from Natural, Industrial and Military sources, Merrill 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)

## **III SEMESTER**

### **1. Environmental Biology (Hard Core):**

**Unit 1-** Ecosystems- Structure, functions, biotic and abiotic components, food chain, types of food chain, food web, Diversity Stability rule, Homeostasis. Ecological niche, spatial functional, Ecological Dominance. Energy flow in ecosystem, Lindeman model, Ecotone & Edge effect, Ecological Pyramids.

**Unit 2** – Environmental factors- Limiting factors, Ecotone & Edge effect: climatic factors, influence of light on morphology and physiology of plants, characteristics of heliophytes and sciophytes, temperature – thermo periodicity, effect of low and high temperature on plants and animals. Atmospheric humidity-relative humidity in relation to metabolism of organism with suitable examples. Wind-mechanical effects of wind; lodging, breakage, deformation, anemophily and anemochory, physiological effects of wind. Edaphic factor-soil complex-soil erosion and soil conservation.

**Unit 3** –Population ecology. Characteristics, population density, natality, mortality, age distribution, population growth, causes for population explosion, population control.

Biological interactions- Intraspecific and interspecific interactions, types of interspecific interaction- neutralism, positive interaction- negative interactions, both positive and negative interactions-Amensalism, mutualism, commensalism, parasitism and predation.

### **Practicals:**

1. Study of binocular compound microscope/ Positive/ Negative staining of bacterial sample
2. Study of microbial flora/planktons found in water/soil samples including pond bottom sediments
3. Determination of Total alkalinity of different water samples
4. Estimation of chloride in the water samples
5. Determination of DO in water sample modified Winkler's method
6. Estimation of Nygaard's algal indices in a given water sample
7. Identification of specimen/culture/materials of ecological interest definition and hardness
8. Determination of Total Hardness of different water samples

### **References:**

1. General Ecology – Kumar H.D et. al, Vikas publishing house Pvt. Ltd. New Delhi (1995)
2. Fundamental Ecology, Odum E.P.III Ed, Saunders, (1971)
3. Ecology – Culvinox P, John Wiley and Sons, (1986)
4. Ecology and Environment – P.D.Sharma, Rastogi Publications, Meerut India
5. Ecology – Krebs J, II ed, Harper international
6. The Ecology of Tropical lakes and Rivers Payne A.I. John Wiley (1986)
7. Concepts of Ecology – Kormondy-Prentice Hall
8. Cell biology and evolution. P.S.Verma and Agarwal I ed. Chand and company, New Delhi (1974)
9. Cell Biology- by De-Roberties
10. Animal behavior M.P.Arora, Himalaya Publishing House.

## **2. Air, Noise and Radiation Pollution (Hard Core):**

**Unit – 1** Air pollution; Natural and anthropogenic sources. Transportation and dispersion of pollutants, Gas laws governing the behavior of pollutants in atmosphere, Properties of air pollutants, Air quality: air quality monitoring- objectives, conventional monitoring, Non conventional approaches, sampling methods, gaseous sampling, stack monitoring, monitoring of particulates and smoke- Air quality standards.

**Unit- 2** Air pollution effects on vegetation, animals and humans, Air pollution control measures. Indoor Air pollution: Sources-Indoor chemicals used, Checking the Indoor pollution, Indoor air quality. Odour pollution of air, preventive measures of odour pollution, Vehicular Pollution: Automobile emission- Types of emissions- Exhaust emissions, evaporative emissions, crank-case emissions. Prevention and control of vehicular pollution.

**Unit- 3** Noise. Source of noise, Reasons for Noise pollution, physical characteristics of sound waves: anatomy of sound, Theory of noise measurement – Sound pressure, loudness, sound intensity. Effects of noise pollution- Physico-chemical, social and psychological effects of noise, Prevention and control of noise pollution, Industrial noise control. Government rules to check noise pollution.

**Unit-4** Radioactivity-Introduction, Disintegration types, units of radioactivity, interaction of radiation with matter, ionization, types of exposure, detection and measurement of radiation, Dosimeters, Biological effects of radiation. Stochastic and deterministic effects, Radiation protection, system of dose limitation, protection methodology.

### **Practicals :**

1. Determination of SO<sub>2</sub> by PRA method
2. Determination NO<sub>x</sub> by spectrophotometric method
3. Basic radioactive measurement procedures using GM counter
4. Studies on indicators of air pollution
5. Measurement of noise level in different environments by sound level meter (SLM)
6. Determination of particulate matters PM<sub>10</sub> and PM<sub>2.5</sub>
7. Field visit to assess air and noise pollution.
8. Determination of radiation in a given area using dosimeter

### **References:**

1. Environmental Chemistry by Sharma B.K & Kaur, Goel publishing House, Meerut (1995)
2. Environmental Science by Santra S.C., New Central Book agency, Pvt. Ltd., Kolkata
3. Chemistry for Environmental Engineering, Sawyer C.N, Mc Marty P.L. and Perkin G.F. Mc Graw Hill, (II ed) (1994)
4. Environmental Chemistry, Tyagi O.D. and Mehra M Anmol Publications, (1990)
5. Environmental Chemistry, Manahan S.E, Lewis Publications, Florida, U.S.A, (7<sup>th</sup> ed), (2000)

## **3. Disaster Management (Hard Core):**

**Unit – 1** Environmental Disasters- Types of Hazards- Natural and Man made hazards- Nature of Hazards, Environmental security and Hazard zoning. Strategies of hazard mitigation. Concept of residence time and rates of natural cycles. Catastrophic-geological Hazards. Earthquake and seismic Hazards- effects of earthquake, stability of structures and risk evaluation, seismic topography. Prediction of earthquake, Volcanic Hazards- Nature of volcanic hazards, volcanic belt, prediction and mitigation of volcanic Hazards.

**Unit 2** – Landslides and Mud flows- Types of mass movement, strength of materials and instability of slopes, controlling the landslides. Floods and flood management- causes of floods, management of floods. Floods control methods. Avalanches- Types of avalanches monitoring of avalanches.

**Unit 3** – Man made Disasters and Hazards- Improper Irrigation, deforestation, Industrial hazards- safety in industry. Management of dangerous materials in Industry, Safety system in industry. Disaster and accident prevention. Safety versus production.

### **References :**



1. Industrial Hazards and Safety, Kind. R.W. and Magic J, Handbook, Butterworth (1982)
2. Introduction of Safety Science, Khulman A, TUV Rheinland, (1986)
3. Explosion Hazards & Evaluation, Barkey, W.E.Elsevier, Amsterdam (1983)
4. Management of Disasters and How to prevent them, Wharband O.P. and Stallworthy, E.A. (1986)
5. Disaster Management – Shailendera, K Singh, Subash. C Kundu and Shobu Singh, Mittal Publications, New Delhi (1998)
6. Disaster Management – Induprakash, Rasthra Prahari Prakashan, Gaziabad (1994).
7. Disaster Preparedness in India – Narendrakumar Jain, Adhytma Sadhan Kendra Mehrauli, New Delhi.

**Any One Paper: (out of papers 4 & 5)**

**4. EIA, Environmental Policy and Laws (Soft Core):**

**Unit 1** - Origin and development of EIA, Assessment and Prediction of impact on Air water, noise and biological environments. Methods of impact analysis, public participation in Environmental decision making, Risk Assessment, mitigation measures.

**Unit – 2 Environmental Audit:** General approaches to Environmental Auditing, Audit methods, benefits of environmental auditing. On-site and Post – Audit activities, statutory Environmental statements. Environmental Management System (EMS), ISO certification.

**Unit 3** – Planning: Importance of planning, local, regional, state and national planning. Zoning-Physical planning. National policy, sectorial – integration, state level policy and implementation. Organizational structure at state and central government levels.

**Unit 4** – Legal control of Environmental pollution in India with special reference to :

- i. The Wildlife protection Act – 1972
- ii. The Water prevention and control of pollution Act, 1974, amended 1988: CESS Act 1977, amended in 1991.
- iii. The Forest Conservation Act, 1980, amended in 1988.
- iv. The Air prevention and control of pollution Act, 1981, amended in 1990.
- v. The Environment protection Act. 1986.
- vi. Hazardous waste management rules-1989 & amendment rules
- vii. Municipal waste management rules 2000 & amendment rules 2016

## References

1. Defense preparedness in India – Jain N.K., Joint assistance center, Adhyatma Sadhana Kendra Mehrauli, New Delhi
2. Environmental Law and Policy in India, Divan.S and Rosencranz. A, Oxford University Press, 2<sup>nd</sup> edition (2001)
3. Pollution control Legislation, Vol. I and II, Tamilnadu Pollution Control Board, Chennai (1999)
4. Environmental Chemistry by Sharma B.K. and Kaur, Goel Publishing House, Meerut (1995).
5. Law and Environment by Ahsok K Jain 2005
6. Environmental and pollution Laws cares and materials by C.S. Lall. 2003
7. Environment and pollution laws by S.K. Mohanty publication year 2013
8. Environment laws in India by satish c Shastri 2012
9. Environment Law by sumeet malik 2<sup>nd</sup> edition 2012
10. Sustainability by Patrick Dixon & Johan Gorecki 1<sup>st</sup> edition 2010
11. Environment Impact Assessment, A.K. Shrivastava, published by S.B. Nangia A.P.H publishing corporation New Delhi (2003)
12. Envi. Impact Assessment Methoddogies lay, Valli Manickan & M Aujaneyalu, B.S. Publication 2011.
13. Methods of Envi. Impact Assessment 3<sup>rd</sup> edition by petter moris & Riki Therivel. Taylor & Francis Groups 2009
14. Saiindia. Gov. in lenglish/home/our-product/Other Reports/Study. Report/Study. Report/Study. Report – Environment – Audit.

## 5. Climate Change and Current Issues (Soft Core):

**Unit – 1** Global Environmental problems - Ozone depletion, causes and effects. Acid Rain

Formation, adverse effects of acid rain. Photochemical smog, Factors responsible for photochemical smog.

**Unit – 2** Green house gases – green house effect and climate change, Global warming Factors – Effects of Global warming – control and remedial measures of green house effect, global warming and climate change, impacts of sea level rise

**Unit – 3** Man and Ecodegradation of Natural Environment, Present status of wasteland in

India. Problems and prospects of wasteland development. Wasteland reclamation through Social Forestry, Bioaesthetic planting for pollution abatement.

**Unit– 4.** Eutrophication and restoration of Lakes. Drug abuse and alcoholism as a threat to

environment. Environmental ethics - stewardship ethics and lifeboat ethics of Garret Hardin. Fly ash utilization, wet land conservation, environmental disaster (man made) episodes; Mina mata, itai itai, London smog, Los Angeles smog, Bhopal gas tragedy.

## References :

1. Environmental Education – Nanda. A.N. (1996)
2. A text book of Environment – Agarwal. K. M. Sikdar. P. K. and Deb. S. C, MacMiller India Ltd., Calcutta (2002)
3. Living in the Environment – Principles, Connections and Solutions – Tyler Miller Jr. G, Wadsworth Publishing Co. New York (1996)
4. Botkin, D.B.Changing the Global Environment, Academic Press, San Diago (1989)

## IV Semester

### 1. Conservation of Biodiversity (Hard Core):

**Unit – 1** Biodiversity – Genetic diversity, Species diversity and ecosystem diversity, alpha, beta, and Gamma diversity, values of Biodiversity – consumptive use value, optional values, productive use value, social value. Biowealth, endemism, significance of the endemism, Hot spots of Biodiversity,

**Unit 2-** Brief account of endangered flora and fauna of India. Red data book and IUCN categories, endangered species, vulnerable species. Rare species. Man- Wildlife conflicts. Ecological consequences of reduction in biodiversity. Biodiversity issues – Deforestation and its impact. Two paradigms of Biodiversity, Convention on Biological diversity (CBD), Man and biosphere programme (MAB).

**Unit – 3** Causes for depletion of biodiversity in India, Biodiversity in Karnataka, conservation measures of biodiversity in Karnataka, Sacred grooves. Prospects and Perspectives of keystone species with special reference to Tiger.

**Unit – 4** Biosphere Reserves – concept of conservation – objectives and management, Nilgiri Biosphere Reserve - Biosphere Reserves in India, *In situ* and *ex situ* conservation, Role of Zoos, National Parks and Sanctuaries in conservation, Biological Diversity Act of India

### Practicals :

1. Determination of density of species using quadrat method
2. Determination of suitability point of a vegetation
3. Determination of frequency and relative frequency of species in a given area
4. Determination of abundance of species in a given area
5. Identification of endangered species of flora and fauna
6. Economic potentialities of selected plants and animals
7. Visit to National parks and sanctuaries
8. Identification of ecological features of selected flora and fauna.
9. Study of adaptive features of hydrophytes
10. Study of adaptive features of xerophytes

### References :

1. Biodiversity – Strategies for Conservation – Dadhich.L.K. and A.P.Sharma, APH publishing corp. New Delhi, 2002
2. Global Biodiversity Conservation measures – Khan. T.I and Dhari. N Al-Ajmi, pointer publishers, Jaipur (1999)
3. An Advanced Text book on Biodiversity – Principles and Practice – Krishnamurthy. K.V, Oxford and IBH publishing, New Delhi (2003)

## **2. Solid Waste Management (Hard Core):**

**Unit 1** – Waste – Introduction, sources, characteristics, composition, classification, waste generated per capita- Global scenario. Solid Waste – collection, Storage, segregation- transportation and disposal methods-sanitary land fills and types, composting, anaerobic digestion, incineration, types of incineration, pyrolysis and medical waste, technology options for biomedical waste treatment

**Unit 2** – Hazardous waste-Introduction, characteristics, resource conservation and recovery act, listed hazardous waste, listing criteria. Classification of hazardous waste and handling of hazardous solid wastes.

Radio active wastes- sources, pollution, types of radioactive waste and its control and management.

**Unit 3** – Waste management – waste minimization program, typical material recovery facility operation (TMRF), Reuse and recycling of paper, glass, rubber. Plastic wastes status in India, effect of plastic wastes on environment, management of plastic wastes, e-waste management.

### **Practicals :**

1. Characterization of solid waste from different sources.
2. Designing of secured/sanitary land fills.
3. To study of methods of management of biomedical waste.
4. Characterization of (TCLP) toxicity characteristic leaching test procedure hazardous waste from different sources.
5. Octevmination of organic carbon in compost.
6. Field trip to municipal solid waste/zero waste management sites/ Biomedical waste plant.
7. Determination of inorganic phosphate in leachate samples.
8. Determination of total nitrogen in leachate
9. Determination of TSS/TDS in leachate sample.

### **References :**

1. Hazardous Wastes and Solid Wastes- Lie, D.H.F. and Liptak, B.G. (2000), Lewis publishers, New York.
2. Solid Waste management in Developing countries – Indian National Scientific documentation center- Bhide and Sundaresan, New Delhi. (2000)
3. Solid waste management- George Tehobanaglou- Milary Theiren and Samuel A vigil, Integrated, Mc Graw Hill Inc, (1993).
4. WHO Manual on solid waste management
5. CPHEEO Manual on solid waste management
6. Hazardous Waste Management, II Ed, La Grega, M.D., Buckingham, P.L. and Evans J.C., Mc Graw Hill Inc., (2001)
7. Bioremediation, Baker, K.M. and Herson, B.S, Mc. Grqw-Hill Inc., (1994)
8. Bioremediation- Principles, Eweis, J.B.Ergas S.J.Change, D.P.Y and Schroeder, E.D. Mc Graw Hill Inc., (1998)

## **3. Major Project work**

**4 Credits**

## **Any One Paper: (out of papers 4 & 5)**

### **4. Environmental Toxicology (Soft Core):**

**Unit – 1 :** Introduction to toxicology, scope of toxicology subspecialties of toxicology, description and terminology of toxic effects, factors influencing toxicity, drug toxicity, biochemical basis of toxicity – mechanism of toxicity and receptor mediated events, acute and chronic toxicity. Selective toxicity. Dose response relationship-graded response time action curves, threshold limit value, LC<sub>50</sub> LD<sub>50</sub>, Margin of safety and toxicity curves.

**Unit – 2 :** Bioaccumulation and Biomagnifications of toxic materials in food chain, Toxicology of major pesticides-Environmental impacts of pesticides, biotransformation, biomonitoring, programs and parameters of biomonitoring, concept of bioindicator, bioindicator groups and examples. Basic concepts of Environmental forensics.

**Unit – 3 :** Concepts of Bioassay- types, characteristics. Importance and significance of bioassay, Field based microbial bioassay for toxicity testing, particulate matter sources, health impacts of specific particulate matter, chronic and acute effects of particulate matters on respiratory system mechanism of impact of particulate matters on cardio vascular system.

#### **Practicals :**

1. Determination of solid food adulteration.
2. Methods of prevention of food poisoning.
3. Determination of liquid food adulteration.
4. Estimation of LC<sub>50</sub> value in mosquito larvae.
5. Determine the histotoxicity/ histopathology of a given sample.
6. Spot test for the detection of nitrate/nitrite poisoning.
7. Histological processing of organs for toxicological tests
8. Determination of fluoride content in a given sample.
9. Determine the differential leukocyte count (DLC) of the pesticide treated blood smear.
10. Paraffin sectioning and staining techniques
11. Determination of toxic chemicals in different samples.

#### **Reference:**

1. Environmental biology and Toxicology, by Sharma P.D. Rastogi and Lamporary., 1994.
2. Environmental pollution and Toxicology by Meera Asthana and Astana D.K., Alka printers, 1990.
3. Toxicology, by A.Sood, Sarup and sons New Delhi, 1999
4. Text book of Preventive and Social Medicine, by Park J.E. and Park K., Banosidas Bharat Publishers, Jabalpur, 1985
5. Environmental Epidemiology, by Anisa Basheer, Rawat Publication Jaipur, New Delhi 1995.
6. Toxicology, Biochemistry and Pathology of Mycotoxins, by Kenji Uroguchi and mikio, Yamazadi Kodansha Ltd., Tokyo, 1978.

#### **4. Marine Ecology and Coastal Pollution (Soft Core):**

**Unit- 1** Marine ecology; Introduction to marine environment, marine bioresources and their economic importance, sources and causes for marine pollution, effect of oil on marine environment, sea level rise and erosion, Tides and types of tides.

**Unit- 2** Coastal pollution; Man made pollution causing coastal pollution, coastal dumping, Status of biodiversity in coastal area, Brief account of benthic fauna, coral reefs and their economic importance.

**Unit-3** Sustainable use and conservation of marine living resources, marine environmental protection, Sustainable development of small islands. Conventions related to marine and coastal environment.

**Unit- 4** Coastal zone management – Specific issues: Habitation, Agricultural land, shrink area, industries, gas fields and sunderban. Ecologically sound coastal zone management program.

#### **Practicals :**

1. Study of phytoplanktons commonly in marine water.
2. Study of Zooplanktons marine water
3. Study of marine benthic community
4. Study of chemical parameters of sea water (pH, conductivity salinity, phosphate).
5. Study tour to explore marine ecosystem.

#### **References :**

1. Biodiversity – Strategies for Conservation – Dadhich.L.K. and A.P.Sharma, APH publishing corp. New Delhi, 2002
2. Global Biodiversity Conservation measures – Khan. T.I and Dhari. N Al-Ajmi, pointer publishers, Jaipur (1999)
3. An Advanced Text book on Biodiversity – Principles and Practice – Krishnmurthy. K.V, Oxford and IBH publishing, New Delhi (2003)
4. Coastal Environments V.Subramanian
5. Coastal Environment and water quality Y.Jon xu and Vijay P. Singh
6. Economic Analysis for Ecosystem – Applications to Marine and coastal Environments Daniel S.Holland, James N.Sanchirico Robert J.Jhonsson, Deepak, Joglekar
7. An Introduction to Marine Ecology, 3<sup>rd</sup> Edition R.S.K.Barnes, R.N.Hughes
8. Marine conservation Ecology Jonday, Mark Zachaias, John Roff
9. Oil Pollution and Marine Ecology Anthony Nelson- Smith

## Open Elective

### **1. Environment and Health**

**Unit – 1** Environmental Health Problems: Health problems related to the environmental degradation, vulnerable groups in society. Environmental factors that can potentially affect health, environment and health indicators, major environmental and health issues, Specific pollutants or issues, indoor and outdoor environment Health problems, Human Bio monitoring.

**Unit – 2** Environmental Risks and the Disease Burden: Environmental risks and the disease burden in different regions of countries and in India, Environmental factors, the burden of disease in India. The health effects of air pollution. Health risks associated with agricultural and industrial pollution.

**Unit – 3** Environmental Health Risks, Assessment and intervention : Introduction, Determination of risk, Risk assessment, Risk assessment methods, Risk monitoring, Risk communication, protecting the public, Risk assessment in public health, Environmental impact studies.

**Unit – 4** Occupational hazards of agricultural workers, somatic disease, accidents, toxic hazards, physical hazards, respiratory diseases, accidents in industry, sickness, absenteeism, health problems due to industrialization.

### **References :**

1. [http://ec.europa.eu/environment/health/index\\_en.htm](http://ec.europa.eu/environment/health/index_en.htm)
2. [http://ec.europa.eu/environment/health/index\\_en.htm](http://ec.europa.eu/environment/health/index_en.htm)
3. Biosafety and Bioethics by Sateesh M.K
4. Essentials of Environmental Health By Robert H Friis
5. Environmental health: ecological perspectives by Kathryn Hilgenkamp
6. Understanding Environmental Health: How We Live in the World by Nancy Irwin Maxwell,
7. Environmental Epidemiology: Principles and Methods by Ray M.Merrill,
8. Environmental Studies by Major Tiwari, Kapil Kulbe, Archana Tiwari, I.K.International.



## **2. Ecotourism and Wild life Management**

**Unit- 1** Ecotourism Concept, definition, scope, characteristics, ecotourism in India, principles and objectives of ecotourism, Advantages and disadvantages of ecotourism.

**Unit- 2** Environmental impacts of ecotourism- Positive and negative impacts- marketing trends in ecotourism, Beach ecotourism and beach pollution, Sustainable Beach ecotourism.

**Unit- 3** Role of environmental education in ecotourism, ecotourism as a conservation tool for wild life ecotourism and sustainable development, Best practices of ecotourism, do's and don't s of ecotourism, World ecotourism summit, 2002.

**Unit – 4** Status of wildlife management in India, Prospects and perspectives of project Tiger in India, Status of Tiger population in India and world, Medicinal importance of tiger parts, conflicts between man and elephants, Economic potentialities of Tiger. Priorities in wildlife conservation.

### **References-**

1. Biodiversity – Strategies for Conservation – Dadhich.L.K. and A.P.Sharma, APH publishing corp. New Delhi, 2002
2. Global Biodiversity Conservation measures – Khan. T.I and Dhari. N Al-Ajmi, pointer publishers, Jaipur (1999)
3. An Advanced Text book on Biodiversity – Principles and Practice – Krishnamurthy. K.V, Oxford and IBH publishing, New Delhi (2003)
4. Weaver D.B., The Encyclopedia of Ecotourism, CABI Publishing, UK(2001)
5. Sinha P.C., Encyclopedia of Ecotourism, VoI II and III, Anmol publications Pvt.Ltd., New Delhi (2003).

### **3 . Environmental Pollution and Management**

**Unit 1-** Water and Thermal pollution- Introduction, types of water pollution, sources of water pollution, effects of water pollution, Primary, Secondary, Tertiary and Advanced treatments for control of water pollution, Thermal pollution- sources, harmful effects, prevention and control.

**Unit 2-** Classification of atmosphere, Air pollution- sources, classification, properties of air pollutants, effects of air pollution on plants and human beings, Control methods for industrial air pollution- fugitive emission and source emission. Automobile pollution and mitigation measures.

**Unit 3-** Soil pollution and Noise pollution- Soil pollution- sources, effects and control measures, noise pollution, sources, effects and control methods. Measurement of noise pollution.

**Unit 4-** Radiation and Bio pollution- Radiation pollution- types of radiations: non ionizing and ionizing, alpha, beta and gamma radiations, cosmic rays and X-rays, sources of radioactive pollution, impact of radiation pollution on human health, preventive measures, bio pollution- aeroallergens, pollen grains, fungi, bio pollutants as biological components.

#### **References :**

1. Environmental Chemistry by Sharma B.K. and Kaur, Goel Publishing House, Meerut (1995).
2. Environmental Biology and Toxicology by Sharma P.D. Rastogi and Lamporary 1994.
3. Environmental pollution and Toxicology by Meera Asthana and Astana D.K., Alka printers, 1990.
4. Environmental Science by S.C.Santra New central Book agency (Private) Limited Kolkata.
5. Ecology and Environment by P.D.Sharma, Rostogi Publications Meerut.
6. A Text book of microbiology by R.C.Dubey and W.K.Maheshwari S.Chand and Co. New Delhi.
7. Environmental Geology valdia. K.S Tata Mac Graw Publishers
8. Soil and water conservation Engineering – Schwab, S.G.etal John Wiley and sons 1975.
9. Soil Resources & the Environment – U. Aswathanarayana, oxford & IBH publishing, New Delhi.

## **4. Environmental Planning and Sustainable development**

**Unit – 1** Sustainable Development – scope and definition, parameters of sustainability, Population stabilization, integrated land use planning, Healthy cropland and grassland, wood land revegetation, conservation of biological diversity, control of pollution, development of non-polluting renewable energy systems. Recycling of wastes/residues, ecologically compatible human settlement and slum improvement, environmental education and awareness, updating environmental law.

**Unit – 2** Agriculture – sustainable agricultural rotation of crops, organic farming. Environmental degradation due to pesticides and chemical fertilizers- Sustainable Management.

**Unit – 3:** Environmental movements and role of NGO's in sustainable development. Global policy for sustainable development – world summits.

**Unit – 4:** Urbanization and its impact on Environment. Rural and Urban planning for sustainable development.

### **References:**

1. Eco-Efficiency: The Business link to Sustainable Development by Livio Desimone.
2. Planning Sustainability by Michael Kenny.
3. Environmentally Sustainable Economic Development by Asayehgn Desta

## **5. Nuclear and Biomedical Waste Management**

**Unit – 1** Nuclear wastes – composition, Decay, scenario of nuclear wastes in the soil, nuclear fuel cycle, Nuclear energy, Management techniques-simple and high level nuclear waste management – Geological disposal. National & International management plans.

**Unit – 2** Introduction, quality of hospital waste, sources of biomedical waste, classification and sources, pathological wastes, sharp pharmaceutical wastes, Genetonic wastes, Chemical wastes, waste contaminated with heavy metals.

**Unit – 3** Measures to reduce biomedical wastes, Treatment of hazardous biomedical wastes, Biomedical waste management in developed countries and in India – legal aspects.

**Unit – 4** E-waste, composition, sources. E-waste management in global and national scenario, Recycling and disposal strategies.

### **References :**

1. Radiation and Man – Jain H.C. National Book Trust, New Delhi
2. Environmental Radioactivity from Natural, Industrial and Military sources, Merril Eisenbud and Thomas Gessell Academic Press, London.
3. Hazardous wastes and solid wastes / Lie DHF and Liptak B.G (2000), Lewis Publishers, New York
4. Hazardous waste Management, II Ed, La Grega M.D., Buckingham P.L. and Evan J.C MC Graw Hill Int. (2001)

## 6. Ecology and Environment

**Unit – 1** Fundamentals of Ecology- Definition, principles, and scope of ecology, objectives and sub-divisions. Concept of levels of organization, Ecological Dominance, Population ecology. Characteristics, population density, natality, mortality, age distribution, population growth, causes for population explosion, population control.

**Unit – 2** Ecosystems- Structure, functions, biotic and abiotic component, food chain, food web, Homeostasis, Ecological Niche, Ecological Dominance. Types of ecosystems : aquatic and terrestrial ecosystem.

**Unit – 3** Resources of environment – Habitat- classification – reasons for depletion of natural resources – conservation of natural resources ; air, water, soil, minerals, forests & wildlife.

**Unit – 4** Ecological Adaptation ; ecological adaptation of hydrophytes, ecological adaptation of mesophytes, ecological adaptation of xerophytes, ecological adaptation of halophytes. Deep sea adaptation, osmoregulatory adaptation

### References :

1. Fundamentals of Ecology 3<sup>rd</sup> Ed. W.B.Saunders & Co.Philadelphia
2. Systems Analysis & Simulation in Ecology Patten B.C. (Ed) 1971  
Academic press London
3. An Introduction to Cybematics Chapman & Hall Ltd. Ashby W.R.  
1956
4. Ecology & Environment seventh edition P.D.Sharma Rastogi  
publication Rajsons Printers, New Delhi (2004)
5. Plants and the Eco-system Macmilian & Co.Laondon Billings W.D  
1964
6. Population Ecology A Unified study of Animals & Plants Blackwell  
Oxford, Begon M and Mortimer. M 1981
7. Environmental Concerns and strategies Indian Environmental Society  
Khoshoo T.N. 1984
8. Ecology with special Reference to Animals and Man Prentice- Hall  
New Jersey, Kendeigh S.C. 1974