SYLLABUS OF M.Sc. (Tech.) APPLIED ENVIRONMENTAL SCIENCE
SEMESTER I:

Paper I: Communication Skill
Unit-I:
Following one-act plays are from Six One-Act play edited by Maurice Stanford. Orient Longman
A marriage Proposal -Anton Chekhov
The Monkey Paw-W.W.Jacobs
Villa for Sale-SachaGuitry
Day of Atonement-Margaret Wood (15)

Unit-II:
Stages of Communication.Channels of Communication Skills.Nature of Technical Communication Skills.Barriers of effective Communication.Organization in Technical Communication.Style in Technical Communication. (15)
Unit-III:
Listening comprehension.Speaking Strategies.Professional Speaking.Group Discussion.Presentation Skills.
(15)
Unit-IV:
Reading and Language Comprehension. Study Skills. Writing Strategies. Professional Writing : Resume's, job application, e-mail, Report, E-Correspondence. Telephonic Conversation. (15)

Books Recommended :
Rizwe M. Ashraf .Effective Technical Communication.Tata MacGraw hill, New Delhi.
Dhanvel, S.P. Text Book on "English and Communication skills for student of Science and Engineering.

Paper II: Foundation Course in Environmental Science

Objectives: This paper introduces the students, coming from disparate backgrounds, to the basics of Environmental Science. Major themes and issues confronting our present day environment are introduced in this paper from a scientific perspective. Each theme in the paper is listed in separate paragraphs.

Unit I:
Definition, History and Scope of Environmental Science,
Importance of Environmental Science,
Organisations and agencies (National and International)
Man and Environment relationship (15)

Unit II:
Evolution of the universe; evolution of the elements; origin of the earth;
Solar system;
Evolution of life;
Atmosphere of the primitive earth. (15)

Unit III:
Components of environment
Factors affecting environment
Types of environment
Debate between environment and development
Environmental management- Objectives and components. (15)

Unit IV
People in environment and their role,
Institutions in environment
Professionals and NGO's in environment protection.
Necessity and awareness on Environmental matters
Environmental movements in India-The Chipko movement, Silent valley movement, Appiko movement, Narmada BachaoAndolan, Tehriand Almettidam conflicts
Ideological trends in Indian Environmentalism
Environmental conferences
International agreements (15)

Paper III: Fundamental Chemistry
Objectives: This course has been designed to acquaint students with natural chemical constituents ofthe environment, the interactions between them and manner in which changes are brought aboutdue to human interference, particular pollution**.**

Unit – I
Concept and scope of environmental chemistry;
Measurement of Mass, Temperature, Volume, Length, Pressure, Density, Viscosity & their Uses.
Introduction to states of matter,
Structure and bonding: covalent, ionic, metallic bonding, lattice energy,
Green Chemistry for Sustainable Future: Reagents, Media, Special Importance of Solvents, Water the Greenest Solvents,
Synthetic and Processing Pathways,
Role of Catalyst, Biological Alternatives,
Biopolymers,
Principles and Application of Green Chemistry. (15)

Unit – II

Introduction to periodic table
Classification of elements in periodic table
Periodic properties
Classification of Elements, Theory of Valency
Concept of specific heat and heat capacity of matter.
Chemical Potential,
Chemical Equilibrium;
Equilibrium electrochemistry;
Kinetic theory of gases properties of ideal gases – diffusion, thermal conductivity and viscosity;
Surface tension; Molecular motion in liquids including electrolytic conduction
Chemistry of decaying compounds - hydrocarbon decay (15)

Unit –III

Solubility of Gases in Water,
Acid – Base reactions,
Common ion effects
Solubility product
Salts
Chemical reactions
Brief discussion on the strengths of organic acids and bases**,**
Principles of Colloidal Chemistry,
Emulsions, Carbonate and Bicarbonate,
Saturated & Unsaturated Hydrocarbons. (15)

Unit –IV

Surface Chemistry: Coagulation, Floculation, Adsorption, Ion Exchange, Activated Carbon and its Application.
Definition and description of various terms: - contaminant, pollutant, receptor, sink, aerosols, particulates,
pathways of pollutants,
hazardous chemicals,
carcinogens, occupier, effluent, (15)

Paper IV: Botany

Unit I:

Introduction to Plant Kingdom, Classical System (Two Kingdom System). Viruses: General characteristics, living and non-living nature, chemical composition, multiplication and economic importance. General characteristics, cell structure, reproduction and economic importance of Bacteria and Cyanobacteria.General characteristics, classification and economic importance of Algae, Fungi and Lichens. (15)

Unit II:

Introduction, Classification and economic importance of Bryophyta and Pteridophyta. Ultrastructure and functions of Eucaryotic Plant cell. Chromosome organization, number and

aberration.Structure of DNA.Genetic code. Cell Division (Mitosis and Meiosis) and its significance. Fundamental of genetic inhertitage, genetic variation and extra-nuclear genome.Gene expression.Protein synthesis. (15)

Unit III: Seed plants: Characteristics and evolution. Concept of Progymnosperms. Gymnosperms: General features, classification, morphology, anatomy of roots and leaf, evolution and diversity. Flower: Structure, development, functions and varieties of flower. Seed and Fruits: Seed formation, fruit development, maturation and significance. (15)

Unit IV:

Angiosperms: Origin and evolution. Taxonomy of Angiosperms: Aims, fundamental components, identification, keys, Botanic nomenclature: Principles and rules, taxonomic ranks; type concepts and principles of priority. Bentham and Hooker classification of angiosperms.Diversity in plant form.Convergence of evolution of tree habit in gymnosperms, monocotyledons and dicotyledons. Morphology and anatomy of root, shoot and leaf. (15)

SEMESTER II:

Paper I: English for Science and Technology

Unit-I:

Language Resource development: Using appropriate grammatical lexical forms to express meaning accuracy, range and appropriacy to context; remedial exercises. (15)

Unit-II:

Reading interpreting and using (a) written, and (b) graphic information: (a) Using (reading and writing) academic texts, articles in technical journals, instruction manuals/ laboratory instruction sheets, safety manuals and regulations, and report; and (b) Using maps, graphs, plan, diagrams, flow charts, sketches, tabulated and statistical data. (15)

Unit-III:

Writing appropriately in a range of rhetorical styles i.e. formal and informal: Writing instructions, describing objects and processes, defining, narrating, classifying, exemplifying comparing, contrasting, hypothesizing, predicting, concluding, generalizing, restarting, reporting; note making (from books/ journals); writing assignments; summarizing, expanding, paraphrasing; answering exam questions and correspondence skills; interpreting, expressing and negotiating meaning, creating coherent written tests according to the conventions. (15)

Unit-III:

Receiving and interpreting the spoken word: Listening to lectures and speeches, listening to discussions and explanations in tutorials. Note taking (from lectures). Interacting orally in academic, professional and social situation. Understanding interlocutor, creating coherent

discourse, and taking apppropiate turns in conversation. Negotiating meanings with other (in class room, workshop, laboratory, seminar, conference, discussion, interview etc.). (15)

Paper II:General Ecology and Ecosystem

Objectives: The purpose of the course is to make the students to understand various ecologicalprinciples and factors that determine the size and number of population that can co-exist within aspecific area. This knowledge is crucial for better development and management of naturalresources and global environment.

Unit- I:

Introduction to Ecology

Ecology- its subdivisions, scope and relation with other life sciences.

Ecological Factors:Abiotic- Temperature, light, water, humidity, current, pressure, weather condition, soil, microclimate and fire

Biotic Factors: Interaction between plants, animals and human. Interaction between plants growing in a community and micro-organisms.

Ecological relationships- Neutralism, Commensalism, Mutualism, Antagonism, Antagonistic Relationship, Symbiosis, Competition, Prediction, Parasitism and Symbiotic Relationship

Community Ecology:Definition, Composition, Functions and Characteristics,

Stratifications, Periodicity, Fluctuations,

Eco-tone and Edge Effect, Ecological Niche,

Eco-types: Classification, Structure and Features,

Stability and Evolution of Community,

Role of Plants, Animals and Microorganisms.

Ecological Succession, Types of Succession, Process, Pattern and Significance, Models of Succession. (15)

Unit -II:

Ecosystem - Concept, components and characteristics.

Ecosystem development and concept of climax.

Primary productivity and methods of its measurements.

Secondary productivity (concept), Law of minimum and Law of tolerance.

Biogeochemical Cycles: Gaseous types – Oxygen, Carbon and Nitrogen,

Sedimentary Type - Phosphorus and Sulphur,

Basic Concept of Productivity,

Productivity of Different Ecosystem,

Measurement of Productivity and the Factor Affecting the Productivity. (15)

Unit -III:

Concept of Producers, consumers and decomposers

Tropic Levels,

Food chain, foodwebs& ecological pyramids.

Ecological indicators of environmental factors.

Energy flow and Energy Dynamics of Ecosystem,
Concept of biotic community.Intra community - classification & the phenomenon of ecological dominance.
Community Analysis.Species diversity within community.
Patterns in communities.
Group properties (Intra specific interactions).
Attributes of population - density, natality and mortality.
Age distribution.
Population growth vis-a-vis the concept of carrying capacity.
Density as a factor in regulating population - density independent and densitydependent factors. (15)

Unit-IV:
Population ecology, Population dispersal.
Population structure - Internal Distribution Patterns, Aggregation and Allee's principle, solation and territoriality.
Interaction within population –
a) Negative Interactions, Interspecific competition, predation,parasitism, antibiosis.
b) Positive Interactions - Commensalism, Co-operation, mutualism.
Population Behaviour - Basic behaviour patterns, Regulatory and compensatory behaviours, Social behaviour.
Character Displacement - Sympatry and allopatry. (15)

Paper III:Inorganic Chemistry
Unit I:
a) Atomic structure- Idea of de Broglie matter waves, Heisenberg's uncertainty principles, Schrodinger wave equation, significance of _ and _, quantum numbers, radial and angular wave functions and probability distribution curves for 1s, 2s and 2p orbital, Shapes of s,p and d orbital. Aufbau and Pauli's exclusion principles, Hund's multiplicity rule. Electronic configuration of elements and ions. (Z=30)
b) Periodic properties: Atomic and ionic radii, ionisation energy, electronic affinity and electrogenegativity- definition, trends in periodic table. Factors affecting ionisation potential, Pauling's and Mulliken's scale of electronegativity, Effective nuclear charge and Slater's rule with some exercise. (15)

Unit II:
a) Valance bond theory, Formation of hydrogen molecule, limitation, directional characteristics of covalent bond, overlap criterion and bond strength, bond energy, bond length, bond order, bond angle, various types of hybridisation and shapes of inorganic molecules. Valance shell electron pair repulsion (VSEPR) theory to NH3, H3O+, SF4, ClF3, ICl2— and H2O.
b) MO theory: LCAO approximation, wave equation for molecular orbitals. Difference between bonding and antibonding, MOs in terms of energy and electron density distribution

curves, order of energy levels in MOs. MO diagrams for homonuclear diatomic molecules of hydrogen, helium and second row of periodic table. Concept of nonbonding MOs in HF molecule.Coulson's MO diagram of CO and NO diatomic mocleucles. (15)

Unit III:

a) Ionic solids: Ionic structure, radius ratio effect and coordination number, limitation of radius ratio rule, Lattice energy and Born-Heber cycle. Solvation energy and solubility of ionic solids, Polarising power and polarisability of ions, Fajan's rule.

b) s- block elements- Comparative study, Atomic and Ionic Radii, Ionisation Potential. Reducing Properties, Metallic Properties, Diagonal Relationship (Li-Mg), Salient Features of Hydrides, Solvation and complexation tendencies including their functions in biosystems, Introduction to alkyl and aryls of Li. Hydrogen Bonding, Classification and effects of Hydrogen on viscosity, Solubility, Melting point and boiling point.

c) p-block elements: Comparitive study of groups 13 to 17: Atomic and Ionic Radii, Ionisation Potential, Electroaffinity, Electronegetivity, Redox Properties, Oxidation State, Diagonal Relationship (B-Si)

Hydrides: Structure and Comparative Study of NH3, PH3, AsH3, SbH3.

Oxides: Structure of P2O3, P2O5, Oxyacids of Phosphorus. (15)

Unit IV:

a) Study of Silicates (Structural Principles) Preparation, Properties and Structure of TetrasulphurTetranitride (S4N4), Basic properties of Iodine, Interhalogen Compounds and Plyhalides.

b) Chemistry of Noble Gases: Chemical Properties of the Noble Gases, Chemistry of Xenon, Structure and Bonding in Xenon Fluorides and Oxyfluorides (XeOF2 and XeOF4). (15)

Paper IV: Zoology

Unit I

Introduction to Animal Kingdom. Protozoa: Structure, nutrition, locomotion and reproduction. General morphological features of Coelenterata, Platyhelminthes, Nematohelminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Hemichordata. (15)

Unit II

General characters of Chordates. Fishes: General morphological features, origin and migration. Amphibia: General morphological features and origin. Reptilia: Classification of Reptilia. Dinosaurs: Origin and extinction. Birds: Origin, general characters, migration, aerodynamics of flight and types of flight. Mammals: General characters, structural peculiarities and distribution. Brief outline of evolution of Man.(15)

Unit III

Cell: Prokaryote and eukaryote cell, animal and plant cell. Structure and functions of nucleus, plasma membrane, golgi complex, ribosomes, mitochondria, lysosomes. Cell reproduction: Cell cycle, meiosis. Concept of genes.Structure of DNA and RNA.Prokaryote and eukaryote gene structure.Genetic code. Genotypic six determination. Human genetics. Genetic counseling, Gene therapy, DNA fingerprinting. Mutations: Genomic, chromosomal and genetic. (15)

Unit IV

Environment: Basic component. Atmosphere: Major zones and importance. Ecosystem: Definition, characteristics and kinds. Food chain, food web and ecological pyramids. Biodiversity: Definition, distribution in biosphere, importance, major causes of reduction, method of conservation. Present status of biodiversity in India. Brief idea about National Parks and Sanctuaries. Sources, general effect and control measures of air, water and noise pollution. Pesticides and pollution. (15)

SEMESTERIII:

Paper I: Environmental Education

Objectives: This paper focuses on methods of communication to the masses and consumers for environmental issues. It also provides an overview of the scenario of environmental education and communication at the national and international levels.

Unit I:

Concept of environment and environmental education,
Background, goals and objectives of environmental education,
Guided Principles of environmental education,
Role of green teacher in Environmental education. (15)

Unit II:

Indoor Environmental education
Environmental education through language,
News papers, Art, Projects, T.V., Games,
Establishment of nature club. (15)

Unit III:

Outdoor Environmental education-
Nature trails, Nature camps,
Celebration of Environmental days.
Environmental Ethics
Role of Information Technology in Environment and Human Health. (15)

Unit IV:

Environmental education in India
Formal Environmental education,
Environmental education at higher secondary stage,

Environmental education at college,
Non formal Environmental education. (15)

Paper II: Aquatic Environment

Unit I:

Aquatic environment- important features
Indian water resources and their status.
Stream gauging,
stream hydrograph.
Properties of fluids: introduction: hydraulics, properties (density, specific weight, specific volume, specific gravity and compressibility),
Types of fluids. (15)

Unit II :

Aquatic ecosystem, major physical and chemical factors (Light, temp, gases and nutrients) ,
Lotic and lentic water bodies and their ecological characteristics,
Production in lakes rivers, eustries, and wetlands,
Nutrient dyanamics in lakes, rivers, eustries, and wetlands
Ecological classification of fresh water organisms.
Plankton: importance and management.
Macrophytes: importance, classification and management.
Aquatic organisms- Fishes, importance, causes of their depletion & conservation.
Aquatic birds: Importance and causes of their depletion. (15)

Unit III:

Lakes: Origin and Classification.
Stratification: thermal and chemical
Springs: origin, importance and classification
Physical characteristics of Lakes, rivers and springs
Chemical characteristics of Lakes, rivers and springs. (15)

Unit IV:

National Water Policy
Causes for dwindling of fresh water resources.
Water conservation.
Ramsar framework for wetland management.
Ramsar's role in water resource management.
Integrated framework for wetland inventory, assessment and monitoring.
Ramsar framework for wetland inventory: core data fields for inventory of biophysical and management features of wetlands.
Wetland Assessment.

Wetland Monitoring.
Development of National Wetland Policy (as per Ramsar convention). (15)

Paper III: Physical Chemistry

Unit- I:

Nuclear Chemistry: Composition of Nucleus, Mass Defects, Nuclear Binding Energy, Average Binding Energy per nuclen, Explanation of nuclear stability on the basis of graph between average binding energy per nucleon and atomic mass number, Nuclear reaction: Fission and Fusion. Nuclear Models: Liquid drop model, shell model and comparison between them, explanation of fission by liquid drop model. Application of radioisotopes. (15)

Unit- II:

Postulates of kinetic theory of gases, Derivation of kinetic gas equation, Deduction of various gas laws from kinetic gas equation.Qualitative discussion of the Maxwell-Boltzmann distribution of molecular velocities. Effect of temperature on molecular velocities, Different types of molecular velocities (Most probable, RMS and Average) and expression for them, their inter relationships, Meanfree path collision diameter and collision number.

Ideal gas and Real gases, Behaviour of real gases, Derivation from ideal behaviour, Explanation of the terms- Compressibility factors and Boyle temperature.Causes of derivation from ideal behaviour.Van der Wall's equation state, explanation of behaviour of real gases.Critical phenomenon (P-V isotherms of real gases).Continuity of states. The isotherms of Van der Wall's equation, Relationship between critical constants and Van der Wall's constants, Reduced equation of state. Law of corresponding state. (15)

Unit – III:

Solid State: Laws of crystallography- Law of constancy of interfacial angles, law rationality of indices, law of symmetry, symmetry elements in crystals.

Unit cell, space lattice, orientation of lattice plane (Miller Indices).Bravais lattices, crystal systems, X-ray diffraction by crystal, derivation of Bragg's equation. Determination of crystal structure of NaCl, KCl and CsCl. Laue's method and Powder method.

Liquid State: Intermolecular forces, Structure of liquids (A qualitative description), Structural differences between solids, liquids and gases, Difference between liquid crystals, solid and liquid. Classification, structure of Nematic and Colestric phases, Thermographic and seven segment cell.

Properties of liquid: Surface tension- Explanation, methods of determination, Capillary rise method and drop number method, Parachor value and its application. Viscosity- Explanation, coefficient of viscosity, Effect of temperature on Viscosity, relative viscosity, Specific viscosity. Method of determination by Ostwald viscometer.Refractive indes- Specific refraction, Molar refraction and chemical constitution.Method of determination by Abbe's Retractmeter. (15)

Unit – IV:

Chemical kinetics: Concept of reaction rate, factors affecting the rate of reaction- concentration, temperature, pressure, solvent light, catalyst. Mathematical characteristics of zero, first and second order reactions. Pseudo order reactions. Half life and mean life of reactions with examples. Determination of order of reaction- method of integration, differential method, method ofhalf life period and isolation method. Experimental mthods based on conductometry, Plarimetryets. Arrhenius equation, concept of activation energy.

Collision theory of bimolecular reactions (Hard sphere model).Transition state theory expression for rate constant based on equilibrium constant and thermodynamic aspects.

Catalsis: Characteristics of catalysed reaction, Classification of catalysis with examples (Homogenous, Gas phase, Liquid phase catalysis, Heterogenous catalytic reaction, enzyme catalysis, Autocatalysis. (15)

Paper IV: Environmental Microbiology

Objectives: The main objective of this course is to make the students familiar with micro organisms without which human could not survive as these microbes occur in large number in most natural environment and bring about many desirable and undesirable changes. Beside their role in evolution of life on this planet, the microbial activity is linked directly with processing and removal of dead bodies and sewage. Thus, their role as scavengers is encouragable. The study of this course will help the students to develop the sustainable environment.

Unit I

Introduction to Environmental Microbiology:Introduction, Scope, Importance of Environmental Microbiology,

Structure of Microorganisms-Fungi, Bacteria, Virus,

Classification of Microorganisms,

Microbial Diversity.

Microbial Methods:Types of Culture, Sterilization and Disinfection,

Techniques used of Enrichment of Culture,

Method of Pure Culture,

Preparation, Maintenance and Preservation of Microbial Culture (Pour plate, Streak plate and Spread plate). (15)

Unit II

Definition, sources of organism in air, Isolation of organisms, techniques- sampling and methods of isolation, beneficial and harmfull effects of air microorganisms, identification of Aeroallegens, Air born diseases and allergies, control of microbes in air. (15)

Unit III:

Introduction to rural and urban water supply, sources of micro-organisms, water sampling, significance of bacteriological analysis of Water, Indicators of pollution, Enumeration of

coliforms (Fecal and Non Fecal) by Multiple Tube Dilution Techniques, Standards of Drinking water Prescribed by WHO and ICMR. (15)

Unit IV

Water Treatment: Potability of water, Objectives, treatment of water for drinking purpose, coagulation, flocculation, sedimentation, filteration (Rapid and Slow Sand Filter), Pressure Filter, Disinfection, Water softening methods, temporary and permanent hardness removal, lime sode process, zeolite process, demineralisation process, colour, odour and taste removal, Iron and Manganese Removal, Fluoridation, Defluoridation. (15)

SEMESTER IV

Paper I: Information Technology

Unit-I:

Introduction to computer: Historical perspectives, history, evolution, characteristics of computer evolution. Definition, characteristics, user, types and classification. Basic anatomy of computers: Block diagram. CPU: Functions of each unit. Memory: Primary, Cheche, Flash. Bus: Organization. Number system: Binary, Octal, Decimal, Hexa Decimal, their conversions, Operations; Addition, subtraction. Data Representation: Using ASCII, BCD, EBCDIC.

Input/output peripherals: Tape, Floppy disk, hard disk, mouse, touch screen. Voice input, MICR, OCR, OMR, Barcode reader and Flatbed Scanner. Output Devices: VDU, Dot matrix, Laser and Injet Plotter. (15)

Unit-II:

Introduction to OS: Its functions and classification. DOS: Warm booting and cold booting. Types of commands, command format, directory, file management, disk management and general commands, path, filters, filters, pipes, DOS editor, Batch files.

Windows OS: Introduction features. Modules: Program, File and Print Managers. Control Panels, icons, Switching between applications, Running MS DOS applications, help and recycle bin. Windows Accessories: Note pad, Paint and Calculators. (15)

Unit-III:

FORTRAN Language: FORTRAN preliminaries: input and outputs; format specifications, control structure, Arrays: Subprograms statement function, function subprogram, subroutine subprograms, files processing.

C-Language: Introduction, constant, variable and data types- operators and expressions. Input/ Output statements: Decision making and branching, looping, Arrays: User defined

functions, structures and unions, Pointers: File managements; Dynamic memory allocation and linked lists. Preprocessors.Introduction to C++. (15)

Unit-IV:

Network: Introduction, Network terminology, topologies, types of networks and their characteristics, advantages and disadvantages, Network protocols, Architecture.
Intranet: introduction, characteristics and advantages, Specific applications of Intranet.
Internet: Addressing data transmission, internet access, Protocol.
World Wide Web: Web pages & HTML, web browsers, search engines.
Applications: sending and receiving E-mail, Managing E-mail addresses, Junk mail. (15)

PaperII: **PhysicalEnvironment**

Objectives: This course is designed to fulfil the needs of students of environmental sciences inunderstanding the internal structure of Earth and various geomorphological processes as well assystems responsible for the formation and modification of landforms on the Earth. This wouldalso serve as a base for different applied aspects of environmental science

Unit - I:

Earth's interior: Different zones in the Earth's interior and their composition.
The Earth's Magnetic Field - Magnetic reversal and magnetic anomaly.
Continental Drift Theory.
Theory of isostasy and global isostatic adjustment.
Rock cycle, Introduction to major rock types.
Physical weathering, chemical weathering and their types
Folds and faults, major types of folds and faults. (15)

Unit II:

The Earth Systems and Biosphere, Conservation of Matter in Various Segments Atmosphere, Hydrosphere, Lithosphere and Biosphere,
Energy Budget of the Earth,
General Relationship between Landscape,
Biomass and Climate.
Climates of India,
Droughts, Cyclones and Disturbance. (15)

Unit III:

Earth Process and Hazards: Catastrophic Geological Hazards,
Study of Floods, Land Slides, Earthquakes and Types of seismic waves and their role in the study ofVolcanism,
Tsunami and Avalanche.
Study of Topographic and Environmental Maps. (15)

Unit-IV:

Factors affecting landform development.
Fluvial system - Factors affecting stream erosion and deposition,

Erosional and depositional landforms.
Underground water system - Water table, landforms formed by ground water action.
Aeolian system - Mechanism of wind erosion, erosional and depositional landforms.
Glacial system - Mechanism of glacial erosion, erosional and depositional landforms. (15)

Paper III: Organic Chemistry

Unit I:

Structure and bond: Hybridisation in case of Methane, Ethene, Ethylene and Acetylene. Bond lengths, bond angles and bond energies. Inductive effects, electromeric effect, Resonance effect, Hyperconjugation, definition, examples and application of these effects, Hydrogen bonding in organic compounds with examples and consequences.

Mechanism of organic reactions: Homolytic and heterolytic bond breaking examples and factors favouring the bond fission. Electrophiles and nucleophiles- definition and examples both neutral and charged.Types of organic reactions- addition, substitution, elimination, rearrangement.Energy considerations. Reactive intermediates- carbocations, carbonions, free radicals, carbine, nitrenes formation, geometry, stability and reaction given by these intermediates. Assigning charges on intermediates and ionic species. (15)

Unit II:

Stereochemistry of organic compounds: concept of isomerism and types with suitable examples. Optical isomerism- elements of symmetry, molecular chirality, enantiomers, stereogeniccenter, Optical activity, properties of enantiomers, chiral and achiral molecules with two stereogeniccenters (Tartaric acid) diastereomers.

Mesocompound, Resolution of enantiomer- biological and chemical methods, Invrsionretension and racemisation, Asymmentric synthesis, Relative and absolute configuration, sequences rules D, L, R and S system of nomenclature. (15)

Unit III:

Alkanes and cycloalkanes: IUPAC nomenclature, classification of carbon atoms in Alkanes.

Isomerism in alkanes, Sources, methods of formation (Ethane) - Wurtz reaction, Kolbe's reaction, Decarboylation of carboxylic acids.Physical properties and chemical reactions of alkanes, Halogenation, nitration, sulphonation, isomerisation, cyclisation aromatisation, pyrolysis and cracking oridation.L.P.G., octane numbers.Mechanisms of free radical halogenations of methane.

Cycloalkanes- nomenclature, methods of formation and chemical reactions- oxidation, aromatisation, chlorination, Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane, theory of stainless ring.

Alkenes and Cycloalkenes: Nomenclature of alkenes, method of formation (Ethylene and Propylene)- dehydrogenation, dehydrohalogention of alkylhalids, dehydration of alcohol.

(15)

Unit IV:

Dienes and Alkynes: Nomenclature and classification of dienes. Methods of formation of 1,3 butadiene. Polymerisation of butadiene and isoprene. Chemical reaction of butadiene- 1,2 and 1,4 additions, Diels-Alder reaction. Nomenclature and bonding in alkynes. Methods of formation of acetylene- from calcium carbide, dehydrogenation of dihalids.Chemical reactions hydroboration- osidation, metal ammonia reduction and polymerisation, Oxyacetylene flame.Acidity of alkynes.

Arenes and Aromaticity: Nomenclature of benzene derivatives. The aryl group, Aromtic nucleus and side chain.Structure of benzene.Molecular formula and Kekule structure. Stability and C-C bond lengths in Benzene Resonance Structure, Molecular orbital picture, Birch reduction. The Huckel rule, aromatic ions, aromatic electrophilic substation- general pattern of mechanisms. (15)

Paper IV: Environmental Biotechnology

Unit I

Environmental Biotechnology:Introduction, Definition and Scope of Biotechnology,
Basic of Environmental Biotechnology,
Biotechnological Approach of Environmental Pollution,
Energy Management and Abatement Bioremediation,
Reclamation and Restoration. (15)

Unit II

Environmental Biotechnology for Environmental Protection:Scope of Biotechnology in Pollution Control,
In-situ and Ex-situ Bioremediation,
Phytoremediation- Metal Phytoremediation, Organic Phytoremediation,
Microbes used in Pollution Mitigation, (15)

Unit III:

Environmental Biotechnology and Sustainability,
Bio-control Agents- Bio-Pesticides,
Bio-Insecticide,
Mushroom Cultivation and Vermiculture.
Bioethics and Biosafety. (15)

Unit IV:

Biogas Production: Anaerobic digestion, enzymatic hydrolysis, acid formation, methonogenesis,
Mechanism of methane formation,
Factors affecting biodegestion,
Types of biogas plants in various countries,
Operation and maintenance of biogas plants. (15)

Labwork I:

1) Standardization of glassware and solutions.
2) Identification and description of Phytoplanktons.
3) Identification and description of Zooplanktons.
4) Estimation of pH of water sample.
5) Estimation of Acidity from provided water sample.
6) Estimation of Alkalinity of provided water sample.
7) Identification of different object on toposheets.
8) Megascopic identification and characterization of different types of rocks.
9) Frequency, density, leaf area estimation.
10) Estimation of biomass in different ecosystems.

Field visit: Tour report certified by the HOD is to be submitted at the time of annual practical examination.

1) Visit to Regional Meteorological Center, Nagpur.
2) Visit to the laboratory and Museum of Geological Survey of India.
3) Visit to Forest Reserve, National Park and Sanctuaries.

Seminar and Home Assignment (Internal Assessment):
One seminar and one home assignment (Compulsory)

Distribution of Marks:

Any four practical : 20 Marks
Viva : 05 Marks
Practical Record : 05 Marks

Tour Report : 10 Marks
Seminar and Home Assignment : 10 Marks

Total : 50 Marks

SEMESTERV:

Paper I: Atmosphere
Unit I
Composition, Structure & Evolution of Atmosphere,
Segments of Environment,
Modern Views Regarding the Structure of the Atmosphere,
Particles, Ions and Radicals in the Atmosphere. (15)

Unit II
Climatology:Definition and Scope, Aims and Objectives of Climatology,
Insolation-Factors Affecting the Distribution of Insolation.
Atmospheric Depletion of Solar Radiation.
Process of Heat Energy Transfer- Radiation, Conduction and Convection. (15)

Unit III
Meteorology:Definition, and Scope, Aims and Objectives of Meteorology.
Primary Meteorological Parameters and their Measurement—Temperature, Wind Direction and Wind Speed.
Secondary Meteorological Parameters and their Measurement—Humidity, Relative Humidity, Absolute Humidity,
Pressure and Solar Radiation.
Collection and Analysis of Wind Data,
Wind Roses, Plotting of Wind Roses
Effects of Meteorological Parameters on Air Pollution. (15)

Unit IV
Green House Gases & Ozone Layer:Introduction, Sources and Effects of Green House Gases- O_2, O_3, H_2O, NH_3, N_2, NO, NO_2, NO_3, CH_4 and CFCs.
Atmospheric Ozone,
Mechanism and Effects of Ozone Depletion,
Climatic Effects and Environmental Disturbances due to Ozone Depletion,

Advance Research to Protect the Ozone Layer,
Antarctic Ozone Hole and Consequences.
Global Climate Change:Energy Balance of the Earth.
Effect on Global Climate, Consequences & Control.
Implications of Climate Change,
Monitoring, Assessment, Research and Prediction Programs,
El-Niño and La-Niño. (15)

Paper II: Hydrosphere

Unit I

Definition; structure of water molecule;
Water Structure and anomalous behaviour of Water,
Properties of water (physical andchemical);
Distribution of water on earth;
Global water balance (GWB); gases in water; (15)

Unit II

Surface, Ground and Frozen Water,
Desalination,
Uses for Agriculture–Energy Generation–Domestic Consumption. (15)

Unit III

Causes for Water Stress,
Water Availability and its Demand.
Dams–Types and Impacts–Alternatives.
Water Conservation Strategies in India–Rain Water Harvesting.
Marine Resources–Chemicals, Food and Energy.
Hydrological cycle, Evaporation, Condensation, Forms of Condensation – Dew, Frost, Fog, Mist, Smog.
Clouds and Cloud Formation,
Classification of Clouds
Role of Clouds in Weather Forecasting. (15)

Unit IV:

Marine Ecology and Oceanographic Environment:
Habitat, Tides, Substrum, Pressure, Temperature and Currents, Light, Salinity, Oxygen,
Plankton, Nekton; Oceanic Plankton And Nekton Biome;
Composition And Characteristics;
Food Chains,
Productivity, Littoral Zone;Sublittoral Zone,
Tidal Pool,

Coral Reef Biome,
Succession to Land; Succession to Freshwater. (15)

Paper III: Lithosphere

Unit I

Definition; structure of lithosphere; soil formation (paedogenesis) – physical,chemical and biological weathering;
soil composition; soil profile;
physico-chemicalproperties of soil;
Methods of soil formation, Major soil types of India
Soil fertility, Soil fertility factors, Causes and maintenance of soil fertility.(15)

Unit II

Introduction to Soil Chemistry,
Physico- Chemical Properties of Soil,
Soil Reactions (Cation& Anion Exchange Phenomenon),
Classification of Soils and their Characteristics, Soil and its organic and inorganic constituents.Electro chemical properties of soil constituents.
Gas and liquid phases in soil. (15)

Unit III:

Soil erosion
Major Nutrients of Soil,
Soil conservation
Soil pollution and remedial measures:Bioremediation and Restoration of Contaminated Soil
Organic farming, microbes and agriculture
Biofertiliser and their Types.
Significance of C:N Ratio. (15)

Unit IV

Nitrogen Pathways and NPK in Soils
Humus composition
Clay-Humus Complex,
Characteristics and functions of humus
Soil degradation its causes and impacts
National wasteland development board (NWDB). (15)

Paper IV: Environmental Biology and Biodiversity

Objectives: This course entails the study of diversity existing at different levels of Biological organization and understanding the essential ecological and biological processes which ensures long terms stability of ecosystems. The course highlights thevalues of biodiversity and scientific approaches to conservation which only can lead to sustainable development and safeguard the interests of future generations.

Unit I

Diversities of life forms:

a) Plant diversity: Plant nomenclature and ICBN; major classes of plants phytogeographical regions of India; Rare and threatened plants; role of Botanical Survey of India inexploration of plant wealth.

b) Animal Diversity: Major categories of animals, rare and threatened species of mammals, aves, reptiles and pisces and India with special reference to N.E. India; role of Zoological Survey of India/Zoo Authority of India in exploration and conservation of faunal wealth.

c) Microbial Diversity: Fundamental concept of microbial diversity:- bacteria, fungi, actinomycetes; microbial diversity in man-made ecosystems and natural ecosystems; importance of microbes in nutrient cycling. (15)

Unit II

Biomes and Conservation of Forest:Biomes of the World with Special Emphasis on Indian Biomes,
Characteristics Features and Different Types of Ecological Indicator.
Forest and its Ecological Significance,
Major Types of Forest,
Deforestation and its Causes. (15)

Unit III

Definition, Level and Types of Biodiversity,
Concept, Significance, Magnitude & Distribution of Biodiversity,
Biogeographically Classification of India,
Values of Biodiversity,
Impact of Biodiversity,
Biodiversity at Global, National & Regional Level.
Methods for Monitoring Biodiversity Trends,
Hotspots of Biodiversity,
Threats to Biodiversity and Causes of Extinction,
ICUN Categories,
Red Data Book,
Endangered Species, Vulnerable Species, Restricted Species,
Methods of Wildlife Conservation Project Tiger,
Project Elephant and Project Crocodile.
Ecological Consequences of Reduction in Biodiversity,

Brief Account of Endangered Flora & Fauna of India. (15)

Unit IV

Biodiversity Conservation Strategies:'*Ex-situ'* Conservation (Zoos) '*In-situ'* Conservation (National Parks and Sanctuaries),
Restoration of Wilderness and Green Cover,
Biodiversity Action Plan: Global Agreement and National Concerns,
Sustainable Utilization,
Research and Developmental Activities, Education and Training Research,
National Policy and Action Plan,
Role of Forest Department in Conservation,
Conservation of Domestic Cultivators,
Integrated Protected Area System, RAMSAR Sites, and Convention on Biological Diversity (CBD), Implementation Process in India.
Biodiversity Legislation, Diversity Act 2002, Biodiversity Rules 2004.
Wildlife Conservation in India:Importance of Conservation,
Reason for extinction of wildlife,
Classification of Scarce Wildlife,
History of Wildlife Conservation,
Wildlife Conservation in India,
Endangered Species of India,
Hot Spot Biodiversity in India. (15)

SEMESTER VI:

Paper I:Introduction to Environmental Pollution

Objectives: This course has been designed to introduce the students with various causes, problems and control of pollution. Pollution of this earth started with the development of intelligence in mankind. But in the modern times, due to population explosion and simultaneous urbanization and industrialization, new problems have plagued the humanity. Consequently, soil pollution, air pollution, noise pollution, radiation pollution, water pollution etc. have become very important.

Unit-I

Air Pollution: Natural and Anthropogenic sources of air pollution,
Primary and Secondary pollutants
Transport and Diffusion of pollutants
Effects of air pollution on human, plants, animals and materials
Air quality standards. (15)

Unit -II

Water Pollution: Natural and Anthropogenic sources of water pollution
Water pollutants
Effects of water pollution on human, plants, animals and materials
Water quality standards
Thermal pollution- sources, effects and mitigation measures. (15)

Unit-III

Soil Pollution: Introduction to soil pollution
Soil pollutants- Insecticides, fungicides and weedicides
Different kinds of synthetic fertilizers and their interaction with soil components
Solid waste pollution: Definition and sources of solid waste
Classification and properties (physical, chemical & biological) of solid waste
Composition of municipal solid waste
Solid waste generation. (15)

Unit-IV

Noise Pollution: Sources of noise pollution
Measurement of noise
Impact on humans
Noise exposure level and standards with reference to Indian context. (15)

Paper II :Hazardous and Radioactive Waste

Unit I

Definition and sources of hazardous waste
Properties and classification of hazardous waste
Environmental effects and problems
Identification and management of hazardous waste
Hazardous waste treatment-

a) Physical
b) Chemical
c) Biological (15)

Unit II:

Offside hazardous waste disposal
Co-disposal and sanitary landfill
Design criteria for a secure landfill and incineration
Guidelines and acts related to management of hazardous wastes in India. (15)

Unit III:

Radioactive pollution: Definition, sources (Natural & Anthropogenic)
Radioactive fall-out (Mechanism and types)
Classification and effects
Protection and control
Units of radiation. (15)

Unit IV:

Disposal of radioactive waste: Methods (Dilution, dispersal, delay and decay, concentrate and contain method)

Recent methods for discposal of critically dangerous radioactive waste

Radiation episodes- Chernobyl- world's worst nuclear disaster. (15)

Paper III: Energy resources

Objectives: The Natural resources of ecosphere are being wastefully consumed at an increasing rate under the combined effect of population explosion & industrialization. The current rate of usage takes absolutely no account of real size of available reserves of natural resources. The needs of future are greatly ignored. In addition to this, malnutrition is fast spreading in most countries of the world, including India. Even advanced countries will no longer be protected from shortages of Natural resources. The course is designed to provide information to the students about the natural resourcse of this planet, the causes of their depletion & their conservation & management for future use.

Unit I

Natural Resources:Definition, Broad Classification, Renewable, Non Renewable and Mineral Resources.

Renewable (Non Conventional Source of Energy):

Solar Energy, Wind Energy,Geothermal Energy,Tidal Energy,Biomass energy (Bio Gas),

Ocean Energy and Magneto- hydrodynamic Power (MHD),

Impact on Environment and their applications,

Non Renewable (Conventional Source of energy):

Thermal Power,

Hydro Energy,

Atomic Energy,

Nuclear Energy (Fission and Fusion) and Fossil fuels (Coal, Petroleum Oil and natural Gas).

(15)

Unit II:

Conservation of Energy:Importance, Methods of Conservation,

Barriers to Energy Conservation,

Measures for Promoting Energy Conservation,

Eco-Friendly Energy Sources, Energy Audit.

Mineral Resources: Metals and Non-Metals,

Formation of Mineral Deposits,

Consequences of over Exploitation and Conservation of Mineral resources of India and their Distribution.

Integrated energy management practices. (15)

Unit III:

Land Resources:Agricultural Practices in India–Exploitation of Agricultural Land.
Range Land Management.
Minerals–Mining,
Quarrying and their Impacts.
Desertification- desert development programmes,
Prevention and expansion of deserts. (15)

Unit IV:

Forest Resources:Importance of Forestry,
Forest Products,
Forest-Based Medicinal and Pharmaceutical Industries
Forest Fire and its Control.
Afforestation and Joint Forest Management – Social Forestry, Agro-Forestry.
Forest Act- Salient Features. (15)

Paper IV: Water Supply and Resources

Unit I

Importance and Necessity of Water Supply Scheme,
Essential of Water Supply Scheme,
Types of Water Sources, Surface Sources- General, Sources of Water,
Streams, Lakes, Rivers, Ponds, Impounded Reservoirs, Stored Rainwater,
Suitability of Surface Water with Regard to Quality and Quantity,
Reservoir Storage Capacity.(15)

Unit II

Ground Water:Infiltration, Porosity, Water Bearing Stratum,
Groundwater flow, Groundwater Yield, Permeability, Groundwater Velocity,
Springs, Infiltration Galleries, Porous Pipe Galleries,
Classification of Wells, Dug Wells or Percolation Well, Yield & Types of Wells, Tube Wells,
Specific Capacity of a Well, Infiltration Well, Artesian Well,
Yield of a Artesian Well, Yield of an Infiltration Gallery. (15)

Unit III

Water Quality of River and Lakes**:** Parameters of Organic Content of Water Quality,
DO and BOD,
Transformation and Transport Process in Water Body,
Oxygen Transfer by Interphase,

Turbulence Mixing in River,
Water Quality in Lakes and Rivers.
Quantity and Quality of Water:Types of Demand, Factor Affecting Rate of Demand, Variations in Rate of Demand,
Measurement of Water Quantity,
Effects of Variation on Design,
Water Requirements for Buildings Other than Residences,
Estimating Population,
Factors Affecting Estimated Population.
Meaning of Pure and Potable Water,
Impurities in Water,
Analysis of Water, Physical Tests, Chemical Test, Bacteriological Tests,
Maintenance for Purity of Water,
Precaution and Preservation,
Water Born Diseases.(15)

Unit IV:
Distribution of Water:Method of Distribution System,
Requirement of Distribution of Water and their Merits and Demerits,
System of Supplying Water,
Types of Service Reservoir,
Different Layout for Distribution of Water,
Design and Maintenance of Distribution System,
Analysis of Pipe Network,
Detection and Prevention of Leakages, Rectification,
Types of Valves, Fire Hydrants, Water Meters. (15)

Lab Work II:

1) Analysis of soil with respect to following significant parameters:
   a) pH and conductivity estimation of soil sample.
   b) Determination of Cation Exchange Capacity of soil sample.
   c) Determination of bulk density and water holding capacity of soil.
2) Estimation of total organic matter in a given soil sample
3) Estimation of chlorides from water sample/ soil lechate by Argentometric method.
4) Estimation of total hardness from water sample by E. D. T. A. method.
5) Estimation of Temporary and Permanent Hardness from water sample by E.D.T.A. method.
6) Determination of moisture content of a solid waste sample
7) Determination of calorific value of a sample of municipal solid waste.
8) Determination of volatile and non volatile matter of a sample municipal solid waste.
9) To determine the relative humidity of air using Psychrometer consisting of wet and dry bulb thermometers.
10) Determinaion of wind speed and wind direction with Cup and Propellor type of Aemometer.

Field visit: Tour report certified by the HOD is to be submitted at the time of annual practical examination.

1) Visit to solid waste dumping site.
2) Visit to Thermal Power Plant.
3) Visit to National Environmental Engineering Research Institute (NEERI), Nagpur.

Seminar and Home Assignment (Internal Assessment):
One seminar and one home assignment (Compulsory)

Distribution of Marks:

Any four practical : 20 Marks

Viva : 05 Marks
Practical Record : 05 Marks
Tour Report : 10 Marks
Seminar and Home Assignment : 10 Marks

Total : 50 Marks

SEMESTER VII:

Paper I: Water Treatment

Unit I
Objective of Water Treatment,
Principles of Water Treatment,
Unit Operation and Unit Processes,
Different Water Treatment Flow Sheets,
Physico-chemical and Bacteriological Parameters and their Role in Water Treatment.
Water Treatment Process:Primary, Secondary and Tertiary,
Theory, Mechanism and Significance ofAeration, Coagulation, Flocculation, Sedimentation, Filtration and Disinfection.
Miscellaneous Treatment Methods,
Removal of Taste and Odour,
Standards for Quality of Treated Water. (15)

Unit II
Filtration:Objectives of Filtration,
Classification of Filters, Filter Media and its Characteristics,
Operation and Backwashing of Filters,
Design Features of Slow and Rapid Sand Filters,
Operational Problems in Water Filters, Pressure Filters,
Disinfection: Necessity of Disinfection,
Method of Disinfection,
Theory of Disinfection,
Residual Chlorine and its Determination,
Chemicals Used for Disinfection of Treated Water,
Application of Chlorine and its Compounds,
Plain Chlorination, Prechlorination, Post chlorination, Super Chlorination,Double Chlorination, Break Point Chlorination,
Role of Ozone and UV as a Disinfectant. (15)

Unit III

Water Softening:Necessity of Water Softening,
Types of Hardness,
Methods of Water Softening, (Lime, Soda Process, Zeolite Process, Demineralization Process) and their Chemical Reactions,
Occurrence of Iron and Manganese in Water, Objectives, Significance and Methods of Removal,
Occurrence of Fluoride in Water, Need for Removal,
Chemical Treatment of Defluoridation and Mechanism, Health Effects,
Methods of Defluoridation, Nalgonda Technique. (15)

Unit IV

Modern Water Treatment Techniques:Introduction,
Removal of Colour, Odour and Taste,
Aeration,
Treatment With Activated Carbon,
De-Salinisation of Brackish Waters,
Distillation,
Reverse Osmosis,
Solar Distillation,
Mineral Waters,
Natural Mineral Water,
Quality Requirement of Packaged Drinking Mineral Waters. (15)

Paper II: Physico-Chemical Treatment of Waste Water

Unit I

Wastewater Sources and Collection and Characteristics:
Domestic and Industrial Wastes,
Measurement of Wastewater Flow Rates with Respect to Channels and Pipelines, Direct Discharge through Velocity and Area Method.
Sources and Factors Affecting Sanitary Sewage,
Rate of Water Supply,
Population Types of Area Served, Effect of Growth of Population,
Determination of Quantity of Sanitary Sewage, Variation in the Quality of Sewage.
Industrial sectors potential source of waste water generation. Industrial sectors generating polluted waste water. Objectives and Systems of Wastewater Collection,
Sewerage and Drainage System, Principle of Design for a Sewerage Scheme.
Quantity of Sewage, Dry Weather Flow,Storm Water, Rational Method and Empirical Formulae for Determining the Quantity of Storm Water.
Industry and waste water generation. Classification of industrial waste water based on its pollution load.

Collection & transport of waste water from industry to effluent treatment plant or common effluent treatment plant. Types of Wastewater Discharge and Characteristic,Physico- chemical and Biological Characteristic of Sewage, Sewage Analysis.Difference in characteristics of waste water from various industrial sectors.
Seasonal variation in industrial waste water generation.
Discharge Loads. Standards for Discharge of Treated Water into Rivers and on Land, Locations for Discharge of Wastewater in River/Sea Water. (15)

Unit II

Wastewater Treatment:General Aspect, Objectives of Treatment,
Location of Treatment Plant,
Design Aspect,
Mode of Treatment Based on Regulatory Guidelines,
Physical, Chemical and Biological Methods,
Unit Operations,
Processes and Treatment Systems Used in Wastewater Treatment,
Treatment Flow sheet,
Plant Layout,
Hydraulic Profile.
Piping & Instrumentation (P & I) diagram . (15)

Unit III

Physical and Chemical Methods of Wastewater Treatment:Theory & design principle of Screen, Grit Chamber, Oil & Grease Trap,
Pre-Sedimentation, Pre-aeration, and Equalization, their Theory, Principles and Construction, Advantages and Disadvantages. (15)

Unit IV:

Introduction, Principle of Chemical Treatment,
Unit Operations Involved in Chemical Treatment,
Design Aspects. Methods of Treatment,
Chemical Coagulation, Flocculation, Sedimentation, Filtration, Air Stripping,
Ion Exchange Carbon Adsorption,
Reverse Osmosis,
Clarifiers, Efficiency of Chemical Precipitation.
Mounted Sewage Treatment Plants. (15)

Paper III: Biological Treatment of Waste Water

Unit I:

Biological Treatment of Wastewater-

Anaerobic Treatment: Basic Principles of Anaerobic Treatment,
Structure, Properties and Function of Biofilm,
Types of Anaerobic Reactors and Processes – Thermophilic&Mesophilic reactors,
Fixed Bed, Moving Bed, Expansion Bed, Fluidized Bed, Recycled Bed,
Upflow Anaerobic Sludge Blanket Reactor (UASB),
Continuous stirred tank reactor (CSTR).
Anaerobic Digestion and Sludge Treatment:Introduction to Anaerobic Digestion, Microbiology of Anaerobic Digestion,
Reactor Configurations, Methane Production,
Applications of Anaerobic Digestion, (15)

Unit II:
First Stage of Treatment of Sludge,
Second Stage of Treatment of Sludge, Sludge Disposal.
Sludge Bulking, Sludge Volume Index, Sludge Density Index,
Aerobic Treatment : Basic Principles, Design Consideration and Working of Aerobic Treatment Technologies - Aerated lagoon, Trickling Filters, Rotating Biological Contractor, Aerobic Biotowers.
Activated Sludge Process:Properties of Activated Sludge,
Actions of Activated Sludge,
Flow Diagram of Activated Sludge,
Method of Aerations,
Advantages and Disadvantages of Activated Sludge Process,
Stabilization Pond and Rotating Biological Contractor (RBC). (15)

Unit III:
Operation & Maintenance of Wastewater Treatment Plant:Objectives of Operation of Wastewater Treatment Plant Units,
Probable Trouble Shooting Parameters and their Control,
Maintenance Procedures for Screens, Grit Chamber, Skimming Tanks, Primary and Secondary Primary Sedimentation Tanks, Filters, Stabilization Plants,
Necessity for Raw Water Conservation.
Water Conservation, Recycle and Reuse of Treated Wastewater,
Tertiary Treatment, for Reuse.
Concept and Guidelines of Common Effluent Treatment Plant (CETP),
Combined Effluent Treatment Plants and Sewage Treatment Plants. (15)

Unit IV:
Advanced Wastewater Treatment:Concept of Zero Liquid Discharge.
Advanced Units & Technologies and their application - High Rate Solid Contact Clarifier (HRSCC), Dissolved Air Floatation Unit (DAF), Submerged Bio-Towers (SBT), Membrane Bio Reactor (MBR) , Reverse Osmosis (RO) , Multi Effect Evaporator (MEE), Skid

(15)

Paper IV: Air and Noise Pollution Control Technology

Unit I

Introduction to Air Pollution:Introduction to Air Pollution,
Classification of Air Pollutants and their Sources, Acid Rain, Photochemical Smog,
Effects of Air Pollutants on Man, Animals, Plants and Materials,
Air Pollution episodes and Air Pollution Control Measures.
Standards Prescribed for Air Quality in India.
Air Pollution Index, Types and Uses.
Atmospheric Photochemical Reactions,
Reactions of Nitrogen Oxides in Urban Atmosphere,
Reactions of Hydrocarbons in Urban Atmosphere. (15)

Unit II

Air Sampling & Monitoring:Criteria, Selection of Sampling Locations,
Analytical and Instrumental Techniques Used in Estimation of Atmospheric Pollutants (Particulate Matter and Gases),
Stack Sampling, Considerations Sampling,
Point Selection for Circular and Rectangular Ducts,
Sources Sampling Equipments for Gases and Particulars.
Methodology of Measurement of SO_2, NO_2 and Dust.
Collection of Particulates, Dust Fall Jar, High Volume Sampler,
Sampling Methods for determination of Sulphation Rate, Sulphur Dioxide, Oxides of Nitrogen, Carbon Monoxide, Hydrocarbons, and Volatile Organic Carbons (VOC).
Ozone.Air Quality Standards and Index (National and Eurostandards). (15)

Unit III

Industrial Air Emission Control:Introduction, Characterizing the Air Stream,
Equipment Selection, Principle & Design—Condensation, Absorption, Adsorption, Filtration, Impingement Separator, Scrubbers, Electrostatic Precipitator, Fabric Filters, Cyclones Collector, Gravity Settling Chamber. Flue Gas Desulfurization,
NO_X removal, Fugitive Emissions.
Role of Green Belts. (15)

Unit IV

Noise Pollution:Basic Properties of Sound, Sound Pressure and Intensity Levels,
Equivalent Sound Pressure Levels (leq),
Noise Pollution Levels (npl), Sound Exposure Levels (sel)
Measurement of Noise, Decibel Scale, Equipment used for Noise Measurement
Sources of Noise Pollution,

Physiological and Psychological effects of Noise Pollution,
Noise Control Criteria, ,
Control Measures of Noise Pollutions,
Noise Control and Abatement Measures,
Sound Absorbing Materials, Acoustic Silencers, Mufflers, Barriers, Vibrations and Impact Isolation.
Permissible exposure Limits,
Noise Pollution Control in Industries,
Standards Prescribed for Noise in Indian Context. (15)

SEMESTER VIII:

Paper I: Remote Sensing and Geographical Information System
Unit I:
Remote sensing: Definition, Concept of Electromagnetic radiation (EMR);
Electromagnetic Spectrum; Radiation principles, Scope of remote sensing
EMR interaction with Atmosphere & Terrain
Platforms and Sensors: Classification of Platforms, Basic Characteristicsof Sensors and Spatial, Spectral, Temporal, Radiometric resolutions
Remote sensing systems: Framing and Scanning Systems
Introduction to IRS, LANDSAT - 5, 7 and SPOT - 4, 5, IKNOS, NOAA,INSAT, satellites and sensors. (15)

Unit II :
Aerial Photography: Definition, Basic information, Specifications forPlanning and execution of aerial photography.
Types of aerial photographs & informationrecorded on aerial photographs.
Brief information about Tilt, Swing, overlap of aerial photographs.
Fundamentals of photogrammetry: Taking measurements from aerialphotographs i.e. Scale of aerial photographs, distance, area.
Stereovision, Stereoscopes,
Measurement of height of objects by Parallax method. (15)

Unit III:
Microwave Remote Sensing: Introduction, advantages, Active remotesensing components, Radar Operating Principles, Spatial resolution in
RADAR, SLAR, SAR, Space borne RADAR
RADAR return, image Characteristics &interpretation of radar images
Thermal Remote Sensing: Concept, Thermal Infrared Radiationproperties, application of Thermal infrared remote sensing.
Geographical Information System (GIS): Definition, Components ofGIS, Geographical data & database structures. Spatial data models viz.raster and vector, Data input & output in GIS.
Remote sensing & GIS application in Forestry

Remote sensing & GIS application in Ecology & Environment.
Remote sensing & GIS application in Agriculture, Soil survey and soilmapping
Remote sensing & GIS application in Land use/ land Cover & landevaluation.
Remote sensing & GIS application in Disaster Management. (15)

Unit IV :
Visual Interpretation of aerial photographs & Satellite images
Digital Image Processing: Digital Image & image structure, hardware andsoftware requirements for digital image processing.
Image restoration: Radiometric and geometric errors and their corrections
Image enhancement: Contrast, Contrast enhancements- linear and nonlinear, edge enhancement.
Information Extraction: Principal component analysis, Imageclassification- unsupervised and supervised, change detection. (15)

Paper II:Environmental Chemistry and Instrumentation:
Objectives: The main object of this course is to acquaint student with number of instruments & related analytical methods that can be used for characterization of pollutants in the environment & quantification of observation.

Unit I:
Classification of Industries Based on Environmental Impacts,
Criteria for Selection of Site for Establishment of Industry,
Socio-economic and Environmental Impacts of Industries,
Legal and Statutory Requirements,
Manufacturing Process and the Sources of Wastes,
Characterization & Treatment of Industrial Waste with respect to Paper and Pulp, Tannery, Textile, Dairy, Sugar, Petrochemical, Pharmaceutical, Oil Refinery and Power Plants-Thermal, Gas Based and Hydroelectric. (15)

Unit II:
Chromatography:Definition of the Term Chromatography-Theory of Chromatographic Separation, Stationary and Mobile Phases,
Classification of Chromatographic Separations.
Gas Chromatographic Techniques–Instrumentation- Criteria for the Choice of Mobile and Stationary Phase.
Detectors–Flame Ionization Detectors. (FID) Electron Capture Detectors (ECD) and Thermal Conductivity Detectors (TCD).
Advantages of Gas Chromatography coupled with Mass Spectrometry (GC-MS).
Liquid Chromatography: Choice of Solvents and Stationary Phases- Characteristics of Various Stationary Phases in Chromatography,
Thin Layer Chromatography and Paper Chromatography. (15)

Unit III:

Absorption Spectrophotometry:Principle, Colorimetry, Lambert's Law, Beer's Law.
working and applications of various instruments like UV-VisibleSpectrophotometer, Infra red (IR) Spectrophotometer, Nuclear Magnetic Resonance (NMR), Atomic Absorption Spectrophotometer (AAS),
Flame Photometer,
Conductivity Meter,
Nephalometer/Turbidity Meter and pH Meter.
Electro Chemical Techniques:Introduction, Types of Electro Chemical Technique,
Principle, Instrumentation and Application of Polarography in Environmental Chemical Analysis, Aniodic Stripping,
Voltametry with its Application in Environmental Measurements,
Speciation of Heavy Metals like Copper, Cadmium, Mercury, Nickel &Arsenic in Natural Water System.Ion Selective Electrodes: Basic Principles, Classification of Electrodes,
Measurement Methods,
Instrumentation and Application in the Analysis of Fluorides, Nitrates, Cyanides, Ammonia, Sulfides.
Redox Potential Measurement and its Significance in Environmental Monitoring.(15)

Unit IV

Modern Instrumental Techniques:Atomic mass Spectrometery,
Molecular Mass Spectrometery,
Mass Spectrometric Applications in Environmental Analysis,
Radiochemical Analysis,
Inductively Coupled Plasma Spectroscopy (ICP),
Aerosol Time of Flight Mass Spectrophotometry (ATOMFS).
Control Charts: Principle of Control Charts,
Observation Required for Control Charts,
Construction of Control Charts.
Significance of Test,
Quality Assurance & Quality Control in Environmental Analysis,
Application of Statistics to Common Analytical Situations.
Definition and Concept of Probability
Positive & Negative Deviations from Accurate Results,
Addition and Multiplication Law of Probability and Examples. (15)

Paper III: Disaster Management

Objectives: :

Disasters are all pervading phenomena in human affairs. These disasters strikesudden, unexpected & are wide spread. Environmental degradation which is often a result ofeconomic

development & associated human settlement patterns that ignore appropriate resourcemanagement can increase a country's vulnerability to natural hazards & aggravate the impacts.This course is designed to familiarise the students with various concepts of disasters & theirmanagement which include causes & effects of disaster, types, predictability, preparedness,nature of damage caused & also disaster mitigation, pre & post disaster management. The coursewill upgrade the information, knowledge & skill of the students which in turn will enable them toact with confidence in pre & post disaster situations.

Unit I:

Disasters: Meaning, difference between disaster and hazard, causalfactors.

Disaster management cycle.

Man- Made Disasters, types, nature of man-made disasters, generaleffects, concerns for manmade disasters.

Biological disasters: meaning, types, vulnerability, effects, preparednessand mitigation.

Chemical Disasters: Causes and impacts, chemical disaster management,mitigation, preparedness and response. (15)

Unit II:

Nuclear disaster: causes, effects, management.

Fires-I: Characteristics of fires; Building, coal, and chemical fires; causes;safety and prevention, safety norms and disaster management.

Forest fires, their types, causes, impacts, mitigation and control.

Desertification: Causes, general characteristics and effects & mitigationmeasures.

Transportation Accidents: types, causes , impacts and disastermanagement. (15)

Unit -III

Natural disasters: introduction, meaning and nature, types of naturaldisasters, general effects.

Earthquake: General characteristics, vulnerability, causes, impacts relatedto earthquakes, prediction, warning and mitigation measures.

Volcanic eruptions: Nature and causes, volcanic hazard monitoring,mitigation.

Landslides: General characteristics, Causes, vulnerability, effects,prediction & warning, risk reduction mitigation measures.

Snow Avalanches: Avalanches formation and classification, hazard mitigation and management.

Cyclone: Formation, General characteristics, vulnerability, effects,Forecasting & warning, mitigation measures.

Floods: General characteristics, vulnerability Causes and impacts,forecasts & warning, Flood Plain zonation, mitigation measures.

Drought: Meaning, types, General characteristics, Causes and impacts,vulnerability, prediction & warning and mitigation measures.

Heat and Cold Waves: introduction causes and impacts, prevention andpreparedness, Response.

Tsunami: General characteristics, causes, impacts and mitigation. (15)

Unit IV :

Disaster Response: Disaster response plans, Search, Rescue andevacuation, Community Health and Casualty Management and damageassessment.
Risk and Vulnerability assessment: Risk, Vulnerability, their concepts,elements at risk, Risk analysis techniques, vulnerability identification andfactors associated with vulnerability.
Disaster preparedness: Concept and nature, Disaster preparedness plans,Role of Information, education, communication, & awareness.
Disaster mitigation: Concept, principles, mitigation approaches andstrategies.
Recovery: Rehabilitation, its social and economic aspects, Housing toresist disasters, relocation, retrofitting, repairing and strengthening ofhouses. (15)

Paper IV: Basics of Environmental Economics

Objectives:

The relationship between economic development and the environment requires manychoices. Some basis for making rational choices is absolutely necessary for making any decision.The economic approach views the environment as a composite asset, supplying a variety ofservices to society . The intensity & composition of these services depend on the actions ofhumans as constrained by the physical laws. Economics has different means of enhancing theunderstanding of environmental & natural resource economics. These approaches are useful indescribing the actions of the people and the impact of those actions on the environmental assetand provide guidance on how optimal service flows can be defined and achieved. This coursehas been designed with an objective to make the students with Environmental Sciencesbackground aware about the causes and consequences of economic growth, role of naturalresources and environmental control , in the growth process and better understanding about howchoices are made in economic & political systems and how these choices affect, and are affectedby the natural environment.

Unit I:

Environmental economics : concept and scope, Environment &development .
Market failure and Externalities : concept, types and solutions.
Environmental valuation : concept, relationships and general principles
An introduction to Valuation methods : Hedonic property values andhousehold production models.
Cost- Benefit Analysis for Environmental Assessment : An overview.

Unit II:

Optimal use of non renewable and renewable natural resources.
Concept and indicators of sustainable development.
Integrated Environmental accounting for sustainable development .
Environmentally corrected GDP- An introduction.ISO - 14001 an outline.

Unit III:

Population, poverty and Environment : Relationships.
Common property resources & people's participation in theirmanagement.

Economic measures to create incentives for Environmentalmanagement

Unit IV:
Overview of National Environmental policy, 2006
Clean development mechanism and carbon trading to combat Global
Climate Change.

SEMESTER IX:
Paper I: Environmental Management:
Objectives: Remote Sensing Technology has developed remarkably as an important tool for scientific management of resources & environment. The technology improves our understanding of both global & local environments & to map & monitor changes in these environment. Remote Sensing application for natural/physical resources assessment, is helpful to improve our ability to achieve the goal of optimum land use planning & in turn sustainable resource management & development. This course has been designed with the objectives to acquaint the students with basic remote sensing principles, concepts & their applications in various fields.

Unit I
Ecosystem Management: Ecosystem Management,
Exploitation (Overuse and Misuse) and its Consequences for the Ecosystem,
Sustainable Management of Ecosystems,
Management of Biodiversity (In-situ and Ex-situ Conservation),
Habitat management,
Species Conservations,
Prevention of Extinction.
Wildlife Management: National Parks and Wildlife Sanctuaries, I
ntegrated Protected Area Systems,
Mitigation of People-Wildlife conflicts. (15)

Unit II
Water and Soil Management:Water as a Resource,
Traditional Water Harvesting Systems,
Management of Riverine Systems,
Wetland Management and Conservation.
Soil as a Resource,
Consequences of Soil Degradation,
Process of Soil Degradation,
Assessment of Soil Erosion,
Soil Conservation Measures,

Afforastation. (15)

Unit III

Remote Sensing and GIS:Definition, Principles and Scope of Remote Sensing. Electromagnetic Radiation,
Atmospheric Window, Platforms, Sensors and Type of Scanning Systems,
Basic Characteristics of Sensors; Salient Features of Sensors Used in LANDSAT, SPOT and Indian Remote Sensing Satellites.
GIS Technology and Its Uses in Environmental Science,
Hardware and Software Requirement for GIS.
Application of GIS: In Agriculture,
Environmental Management and Land Use,
Land Cover. GPS (Global Positioning System): Basic Concepts, GPS Positioning Techniques,
GPS Procedures,
Role of GPS in GIS and Remote Sensing. (15)

Unit IV

Current Issues and Environmental Problems:Environmental Education and Awareness, Waste lands and their Reclamation,
Water Crises-Conservation of Water,
Eutrophication and Restoration of Indian Lakes.
Scheme of Labeling of Environmentally Friendly Products (Eco Mark),
Stockholm Conferences,
Copenhagen Conference,
Durban Conference and Worldwide Environmental Issues.
Role of NGO in Environmental Management,
Concept and Strategies of Sustainable Development,
Cost Benefit Analysis,
Environmental Priorities in India. (15)

Paper II:

Solid & Hazardous Waste Management:

Unit I

Nature of Solid Waste:Introduction, Classification and Origin of Solid Waste,
Characteristic of Solid Waste,
Methods of Solid Waste Treatment and Disposal, Pyrolysis, Recycling and Reuse of Solid Waste and Management, Solid Waste Handling Methods, Segration and Salvage,
Recovery of the Bio Products,

Public Health Aspect Related to Solid Waste,
Status of Municipal Solid Waste in India. (15)

Unit II

Solid Waste Management:Introduction, Vermiculture, Composting, Biogas from MSW, Land Fill (Site Selection, Site Investigation and Site Characterization),
Landfill Planning and Designing,
Construction and Operational Practices,
Landfill Quality and Control.
Indian Scenario and Legislative Control,
Municipal Solid Waste (Management and Handling Rules 2000). (15)

Unit III

Hazardous Waste:Definition, Classification, Identification, Sources and Characteristics of Hazardous Waste,
Integrated Approach for Minimization of Air, Water and Solid Pollutants,
Collection, Storage, Transportation,
Hazardous Waste Testing in Terms of Toxicity,
Corrosivity, Ignitability and Reactivity,
Priority Pollutants,
Acute and Chronic Toxicity,
Bioaccumulation,
Mutagenicity,
Teratogenicity Carcinogenicity and Genotoxicity.
Hazardous Waste Treatment:Treatment and Disposal Alternatives,
Physical, Chemical and Biological, Thermal Destruction of Hazardous Wastes,
Incineration, Pyrolysis, Wet Air Oxidation.
Containment Technologies,
Immobilization and Solidification,
Secured Landfill, Land Farming,
Bioremediation, Biodegradation of Recalcitrant, Xenobiotics Treatment.
Guidelines for Identification of Landfill for Hazardous Waste Disposal. (15)

Unit IV

Hazardous Waste Management:Hazardous Waste Treatment Facility- Planning of Hazardous Waste Incinerator & Inorganic Waste Treatment Plant,
Leachate Management.
Waste Minimization,
Recycle and Reuse of Hazardous Waste,
Recovery of Chemicals from Hazardous Wastes.
Management and Handling Rules, India-1989.
Categories of Biomedical Waste.
Contaminated Site Remediation- *Ex-Situ* and *In-Situ* Approach, Landmark Episodes.

(15)

Paper III: Environmental Impact Assessment and Legislation:

Objectives: The environment Impact Assessment is among the tools which in recent yearshave been employed widely to determine the impacts of various activities on the environmentwith a view to avoid or mitigate such impacts. Deterioration in environmental quality increasedwith the increase in human activities. The objective of environmental impact assessment is tomake available, information on the environmental repercussions of impacts of a project or otherdevelopmental activities. The main purpose of this course is to apprise the students of variousprinciples & methodologies of Environmental Impact Assessment, consequences of developmental projects& other activities of man which in turn will enhance their decision making ability.The main objective of this course is to acquaint the students with elementaryprinciples of environmental Laws to enable them to make proper & effective use of theirprofessional abilities. Because the scientific gains can be put into use within the parameters of alegal system & the science & Law must be subservient to the needs of the society.

Unit I

Environmental Impact Assessment:Definition, Basic Concepts and Principles of EIA.
Nexus between Development and Environment,
Need for EIA, Elements of EIA,
Environmental Attributes,
Nature of Impacts- Primary, Secondary, Tertiary, Short Term, Long Term, Reversible and Irreversible Impacts. Overview of Impacts,
Directly and Indirectly Measurable Impacts of Air, Noise, Water, Land, Biological and Socio-Economic Elements. (15)

Unit II

EIA Procedure:Screening and Scoping in EIA,
Methodologies of EIA,
Checklist, Matrices, Overlays, Cost Benefit Analysis,
Computer Aided EIA,
Battelle Environmental Evaluation System-Impact Identification Networks,
Strategies for Environmental Management Plan and Green Belt Development.
Role of Mathematical Models in EIA.
Environmental Appraisal of Project with Reference to Industry, Mining and water Resources projects-Critical Issues and Formulation of Strategies for EMP,
Strategic Environmental Impact Assessment,
Methods, Benefits, Legislation of EIA in India and Modification.

Role of Statutory Agencies in EIA Clearance. (15)

Unit III

Environmental Audit and EMS**:** Definition, Concept of EA, Types of EA,
Benefits, Scope and Objectives of Environmental Audits,
Procedural Requirements of Conducting EA, Pre-Audit, on-Site Audit and Post Audit Activities,
Water Audit, Raw' Materials Audit and Energy Audit,
Health and Safety Audit-Reuse and Conservation of Water and Energy,
Waste Minimization,
Environmental and Economic Benefits of An Environmental Audit,
ECO- Audit and its Importance in Environmental Management.
Concept of ISO 9000 and ISO 14000 in Environmental System Management.
Environmental Protection Laws in India:Constitutional and Statutory Laws in India, Fundamental Duties and Fundamental Rights,
Statutory Protection of the Human Environment Such as Indian Pinal Code Factories Act, Motor Vehicle Act,
Hazardous Waste, Legislation for Pollution Mitigation. (15)

Unit IV

Environmental Legislation: Legal Control of Environmental Pollution With Reference to:
The Water Prevention and Control of Pollution Act 1974
The Air Prevention and Control of Pollution Act 1981
The Environmental Protection Act 1986
The Wild Life (Protection) Act 1972
The Wild life Protection Rules 1995
The Indian Forest Act 1927
The Forest Conservation Act 1980
The Forest Conservations Rules 1981
Salient Features of Coastal Zone Regulations (CZR) Notification, the Convention of Biodiversity. (Several Case Studies to be given as Assignment). (15)

Paper IV:
Optional Paper (any one of the following papers)

(ELE - 1) Environmental Pollution – Control and Management

Unit I :

Introduction: Global, regional and local perspectives of Environmental pollution;
Causes ofEnvironmental pollution and remedial measures; Concept of pollution control and management,

Environmental quality standards. (15)

Unit II:

Air Pollution: Sources of air pollutants and mechanism of transport,
gas laws governing thebehaviour of the pollutants in the atmosphere;
Sampling and analysis of air pollutants;
Biological indicators of air pollution – bio-monitoring,
Air pollution Indices, Air quality modelling,
National and international laws, Air quality standards.
Air pollution control methods and equipments,
Control of particulate and gaseousemission, Control of SO2, NOX, CO and HC
Air Pollution Meteorology and Modeling: Vertical profile of wind and air temperature,
Atmospheric stability, Presentation of wind data – wind rose;
Plume behaviour, Dispersion ofpollutants,
Dispersion models and computation of ground level concentration;
Effect ofmeteorological and topographical factors on transport and dispersion of pollutants
Indoor and Vehicular Air pollution: Indoor air pollutants, standards, measurements and remedial measures;
Vehicular pollution - Emissions from gasoline and diesel powered vehicles;
Exhaust emission - air fuel ratio spark timing, combustion chamber surface volume ratio.
Control of exhaust emissions: catalytic converters. Emission inventory. (15)

Unit III:

Radiation Pollution: Radiation sources in the environment - natural and man-made,
Disposalof radiation waste;
Radioactive - sampling methods and detection; units of measurements ofradiation energy and radiation absorption
Biological effects of ionizing radiation's - the interactions of radiation's with cells;maximum permissible dose - ICRP recommendations
Noise Pollution : Basic properties of noise - sound pressure, loudness and intensity levels, decibel,
Noise propagation - effect of meteorological parameters;
Noise survey – equipment and sampling
Methods of noise abatement; National and International standards.
Soil and Solid Waste pollution: Degradation of different insecticides,fungicides, weedicides and fertilizers in soil and their effects on soil components.
Toxic heavymetals in soil, Soil degradation due to mining,
Reclamation of polluted and degraded soil.
Sources, nature and chemical composition of solid wastes;
Different methods ofdisposal and management of solid wastes;
Municipal solid wastes;
Alternative methods ofdisposal, recycling, conversion of solid waste into energy and Manure.
(15)

Unit IV:

Water Pollution: Types, sources and consequences of water pollution - ecological and biochemical aspects;
Effects of domestic, industrial and agricultural wastes on water bodies;
Chemical and bacteriological sampling and analysis;
Water pollutants and their control –Bioabsorptionof heavy metals,
Water pollution laws and standards for different kinds of uses;
Eutrophication –Definition, sources of nutrients, N/P ratio, types of eutrophication, effects, control and treatment,
Restoration of Indian lakes, self purification, factors affecting self purification,zones of pollution. Water treatment processes. (15)

(ELE - 2) Environmental Health and Eco-toxicology

Objectives: The purpose of this course is to familiarize the students with various forms oflife substances, forces & conditions in the surroundings of man that may exert an influence onman's health & well being. This would help the students in assessing the peculiar needs ofmodern man & the current environmental hazards to man which are result of man's activities or his modification of environment. The main aim of this course is to make students fit for planning& administration of environmental control programmes.

Unit I:

Overview of Environmental Health: Concept and scope; Global and regional perspectives;
Basic requirements for healthy environment;
Environmental quality,
Human exposure andhealth impact – impact of environmental factors on human health.
Industrial Pollution and Chemical Safety: Extent of industrial pollution, Public exposure fromindustrial sources,
Hazards by industry,
Major chemical contaminants at workplace,
Industrialenvironmental accidents. (15)

Unit II:

Environmental Diseases :Asbastosis, Silicosis, Synosis, Asthma, Fluorosis and Allergies;
Epidemiological issues - Malaria and Kalaazar,
Occupational Safety and Health: The relationship of occupational hygiene/ safety anddisease;
Principles and methods of occupational health,
Health problem due to industrial dust,heat, chemicals, noise, toxic gases and metals,
Health hazard in agriculture - Pesticides andenvironment, Pesticides and human health.
(15)

Unit III:

Environmental Health Hazard and Risk Assessment: Hazard and risk,
Biological, chemical,physical and psychological health hazard;

Health risk assessment and management
Eco-toxicology: Introduction to ecotoxicology, principles of toxicology,
Types of toxicsubstances - degradable and non-degradable; Influence of ecological factors on the effects oftoxicity; sigmoid relationships,
Corollary of toxicology. (15)

Unit IV:
Toxicants in the Environment: Toxic substances in the environment, their sources and entryroots,
Eco-system influence on the fate and transport of toxicants;
Transport of toxicants by airand water;
Transport through food chain - bio-transformation and bio-magnification
Man and Environmental Toxins: Routes of toxicants to human body – entry through inhalation, skin absorption, indigestion and injection;
Response to toxin exposures – Doseresponse, Frequency response and cumulative response;
Lethal and sub-lethal doses;
Dose-Response relationships between chemical and biological reactions.
Analysis of NOEL, LD 50,
LC 50 and MLD; Detoxification in human body - detoxification mechanisms, organs ofdetoxification. (15)

(ELE - 3)URBAN ECOSYSTEMS

Objectives: Much of environmental policy making and popular struggles in India have the rural scenario as their object of inquiry. This paper looks at the emerging importance of the urban setting as the locus of environmental conflict and governance in India, across a range of urban clusters including metros, cities and towns. Their importance for policy, community mobilization, law and governance are explored.

Unit :
City, region and modernity
Places the city in its regional context, both in terms of drawing upon resources and transferring waste. Nature in the city: Parks, Gardens and Public spaces.
Examines the principles and techniques through which green spaces are organized in the city to produce ‘controlled nature’.
Infrastructure
A variety of infrastructure from sewage and water to transport and communication are studied from an environmental perspective.

Unit II:
Planning and environment

Town planning Acts and their environmental aspects are studied across a range of Indian cities. Historical and contemporary developments in urban planning and environmental management are addressed.
Slums and neighborhoods.
Examines the housing scenario across large-medium-small cities and the presence of slums as a specific environmental issue in urban contexts.

Unit III:
Occupational environment
Environmental aspects of a variety of informal and formal work spaces are examined.
Pollution and waste
Major forms of urban pollution - air, water, noise and land - are explored historically and across various urban sites. Spatial dimensions of waste circulation are explored.

Unit IV:
Consuming nature
Introduce the issue of consumption from a variety of perspectives - materials, symbolic and aesthetic.
Energy and environment
Examines the major techniques for providing energy in urban contexts - generation, transportation, usage, alternatives and environmental impacts.
Sustainability and urban futures.Addresses some key challenges facing urban sustainability in the 21st century.

SEMESTER X:

Environmental Sampling and Research Methodology
Unit I
Air Sampling:Objective and Criteria of Air Sampling,
Selection of Sampling Location,
Sampling Methods (Sedimentation, Filtration, Centrifugal and Impingement Method),
Instrumental Techniques used in Estimation of Atmospheric Air Pollutant,
Dust Fall Jar, SPM and RSPM using High Volume Air Sampler.
Water Sampling:Necessity of Water Sampling, 3
Objectives, Selection of Sampling Site, Types of Water Samples,
Collection, Handling and Preservation,
Sampling Equipment,
Classification of Water Quality Parameters (Inorganic, Organic and Nutrient),
Parameters analyzed on the Spot, (Field Parameters)
Data Interpretation,
Basic Concept, Significance and Measurement of DO, BOD, COD, Phenol, Pesticides and Polynuclear Aromatic hydrocarbon (PAH) in Water and Wastewater. (15)

Unit II

Soil and Solid Waste Sampling:Objectives of Soil and Solid Waste Sampling,
Site Selection Criteria,
Collection and Handling of Soil and Solid Waste Samples,
Preparation of Soil Samples for Analysis,
Physico-Chemical Parameters and their Significance (Quality and Productivity). (15)

Unit III:

Errors in Environmental Analysis**:** Nature of Errors,
Types of Errors and Importance of Error,
Random Error,
Estimation of Standard Deviation,
Confidence Limits of Analytical Results,
Combined Effects of Different Random Errors,
Comparison of Two Means,
Comparison of Two Standard Deviations,
Laboratory Quality Control and Assessment,
Correction, Limit of Detection, Bias, Precision and Accuracy. (15)

Unit IV

Research Methodology:Introduction, Research Problem and Design,
Data Collection and Sampling,
Data Representation,
Measure of Central Tendency,
Measure of Variation,
Correlation and Regression,
Testing of Hypothesis,
Interpretation and Report Writing. (15)

Dissertation - Instructions for Student.

Candidates will write a dissertation on issues related to Environmental Science under the guidance of their respective guides. Each student will work independently on the topic. The dissertation must consist of review of literature and produce a deep insight of the subject on the basis of personal research.

Dissertation work will be initiated after passing M.Sc.-I. The students will undertake field wok in terms of collection of data and surveys. The dissertation will have to be submitted at the end of the academic year for appraisal and acceptance by the University. The students should submit their dissertation in the following format.

Chapter I: Introduction with Aims and Objectives.

A background with historical information and a review of existing material or data on the subject along with the aims and objectives of the study.

Chapter II: Methodology with Material and Methods.
Description of the issue, methodology adopted for the study.

Chapter III: Experimental
Presentation of data collected and detailed analysis of results.

Chapter IV: Result and Discussion
Discussion on the data and results obtained and presentation of method suggested to solve the problem.

Chapter V: Summary and Conclusions.
A summary of the dissertation and important conclusions drawn at the end of the investigation.

Chapter VI : Bibliography or References
A list of references of cited in the text.

The dissertation should be typed on A4 size bond paper with 1.5 line spacing. Illustrations and photographs should be of high quality. The report should be flawless without any spelling mistakes or grammatical errors. If the dissertation contains such mistakes the student will have to resubmit their dissertation after the necessary corrections. The dissertation should be bound in hard black mounted cover. Dissertations with spiral binding and paper cover will not be accepted. The students are expected to prepare 4 copies of the dissertation of which three should be submitted to the University.

The dissertation will carry 30 marks. Assessment of the dissertation will be done at the end of the year. Students have to appear for PowerPoint presentation and shall carry 10 marks. Students will have to submit their dissertation one month before the final practical examination. Assessment of the dissertation shall be done by the Supervisor appointed by the RashtrasantTukadojiMaharaj Nagpur University, Nagpur.

Distribution of Marks
Maximum Marks: 90

01.	Introduction & Review of literature	10
02.	Subject Knowledge	10
03.	Efforts Taken	15
04.	Interpretation of Results	15
05.	Reasoning Capabilities	10
06.	Presentation of Work	15
07.	Project Viva	15

A) VISIT TO ATLEST TWO CENTERS OF THE FOLLOWING

i) National Environmental Engineering Research Institute (NEERI), Nagpur.
ii) Remote Sensing Center.
iii) Regional Meteorological Center, Nagpur.
iv) Maharashtra Pollution Control Board, Nagpur.
v) Center for Environmental Education, Ahmadabad.
vi) Tata Energy Research Institute, New Delhi.

B) SEMINAR

Student may select any environmental related topic of their choice (in consultation with the faculty) and make a power point presentation for 30 minutes. They shall be able to answer questions invited from the audience.

C) FIELD DIARY

The student shall prepare their field diary under the following heads

i) Issue on local/regional/national problem of environmental interest (Case Studies).
ii) About famous personalities in environmental movements.
iii) New Acts and Judgments of environmental interests.

D) GUEST LECTURE SERIES:

In each year guest lectures will be given by the faculty and other invited speakers on current topics and environmental issues. The course would run as a guest lecture series (at least five guest lecturers in chosen topics) with compulsory attendance.

NOTE: The syllabus is based on 4 lecturers per paper, per week of 1 hour. Each practical shall be of 8 periods per week (Spread over 2 days).

The examination shall comprise of 4 papers per semester and 2 practical exams annually. Each theory paper shall be of 3 hours duration and shall carry 75 marks. Each practical examination will be of 12 hour duration and will be extended over 2 days. Each practical shall carry 90 marks.

Load Per Week

Class	Per Theory	Per Practical	Per Theory Paper	Practical	Total
M.Sc. I	4 Hrs	9 Hrs	20 Hrs	36 (Two Batches)	56
M.Sc. II	4 Hrs	9 Hrs	20 Hrs	36 (Two Batches)	56

N.B.: Project is considered as the separate paper at M.Sc. Part II and the work load allotted as per theory paper.