DETAILEDSYLLABUS FOR THE POST OF ASSISTANT SCIENTIST (KERALA STATE POLLUTION CONTROL BOARD)

(Cat.No. : 582/2022)

(Total Marks- 100)

Part I : Microbiology (25 Marks)

Module 1: Techniques in Microbiology (5 Marks)

- Microscopy techniques: light microscopy, electron microscopy, fluorescence microscopy, confocal microscopy, and their applications in microbiology.
- Staining techniques: Gram stain, acid-fast stain, endospore stain, and their principles and applications.
- Sterilisation and disinfection techniques: physical methods (heat, radiation, filtration) and chemical methods (alcohols, aldehydes, halogens, etc.).
- Spectrophotometry and calorimetry: principles and applications in microbiology.
- Chromatography techniques: adsorption, partition, ion exchange, gel filtration, HPLC, FPLC, and their applications in microbiology.
- Electrophoretic techniques for proteins and nucleic acids, PCR. Techniques used for identification of microorganisms – biotyping, serotyping, molecular techniques such as PCR, DNA sequencing, and gene expression analysis.

Module 2: General Microbiology and Microbial Physiology (5 Marks)

- Comparison of eukaryotes and prokaryote. Archaebacteria and eubacteria. Bacterial forms and arrangement of cells. Actinomycetes, Mold and yeast forms. Viral and bacteriophage forms.
- Ultrastructure of bacteria. Effect of antibiotics on microbial cells. Structure, function and chemical composition of cell wall and cell membrane. Endospore: Structure, formation, stages of sporulation.
- Effect of various parameters and Environmental factors on microbial growth. Bacteria classification based on specific requirements-based on temperature, pH, O_2 and solute concentration.
- Nutritional requirements of bacteria. Nutritional types of bacteria. Modes of bacterial nutrition. Transport of nutrients by bacteria. Solid and liquid media, use of agar. Different types of culture media.
- Culturing methods-Streak, spread, pour plate methods, stab culture and lawn culture. Cultivation of aerobic and anaerobic bacteria. Culture preservation strategies. Growth curve and its significance.
- Viral growth- lytic and lysogenic stage. Viral cultivation methods. Viral and bacteriophage quantitation methods.
- Bacterial metabolism: energy generation, respiration, and fermentation.
- Microbial genetics: DNA replication, transcription, and translation, plasmids, and genetic recombination.

Module 3: Environmental Microbiology (5 Marks)

- Soil microbiology: microbial diversity, soil fertility, and factors affecting microbial population.
- Aquatic Microbiology: Aquatic environment, distribution of microorganisms in aquatic environment. Factors influencing their growth and distribution. Water Purification procedures for public water supplies, Concept of indicator organisms, Microbiological examination of water. BOD, COD, Wastewater treatment steps and methods. Eutrophication and algal bloom. Brief account of water borne diseases and transmission.
- Aerobiology - atmospheric layers, organisms in air, distribution and sources. Disease forecasting in plants. Indoor and outdoor air. Droplet nuclei, aerosol, infectious dust. Microbiological sampling of air. Air borne transmission of harmful microbes and air borne infections.
- Biogeochemical cycles: role of microorganisms in carbon, nitrogen, phosphorus, and sulfur cycles.
- Microbe-microbe interactions: mutualism, synergism, commensalism, competition, amensalism, parasitism, and predation.

Module 4: Waste Management and Xenobiotic Metabolism (5 Marks)

- Solid waste management: sources and types of solid waste, need for management, and different methods of waste management such as landfills, composting, vermicomposting, anaerobic digesters, and production of biogas.
- Bioreactor design and operation for waste treatment such as anaerobic digesters, aerobic reactors, and membrane bioreactors.
- Xenobiotic metabolism - Novel pollutants, persistence and biomagnification. Recalcitrant halocarbons- nitroaromatic compounds, PCB, alkyl benzene sulphonates, and petroleum hydrocarbons. Microbial detoxification and biotransformation of xenobiotic compounds.
- Bioremediation of polluted environment. Oil spills, heavy Metals and other xenobiotics. Microbial leaching and corrosion of metals.
- Microbial biosensors for monitoring pollutants and their metabolism- microbial biosensors, whole-cell biosensors, enzyme-based biosensors, and immunosensors.

Module 5: Food Microbiology (5 Marks)

- Food as a substrate for microorganisms. Types of microorganisms in food. Source of contamination. Factors influencing microbial growth in foods. Physical and chemical properties of milk. Milk as a substrate for microorganisms.
- Types of microorganisms in Milk- bacteria, fungi and yeast. Sources of microbial contamination of milk. Microbiological analysis of milk.
- Food fermentations: Cheese, bread, yoghurt, idli, fermented pickles and fermented vegetables, Ice cream, - methods and organisms used. SCP, Probiotics and prebiotics.
- General principles underlying spoilage, spoilage of different kinds of foods.

- Principles of food preservation. Physical and chemical methods of preservation. Food Sanitation, good manufacturing practices, HACCP and personnel hygiene.

Part II : BIOTECHNOLOGY (25 Marks)

Module I

Biophysics and Principle of Instrumentation **Marks: 3**

Principles of thermodynamics:
Laws of conservation of energy- first and second laws and its relevance in the biological system, entropy and enthalpy, Gibbs free energy, bioenergetics- endothermic and exothermic reactions of biological systems, energy change in the biochemical reactions, sources of heat limits to temperature, heat dissipation and conservation.

Colorimetry and Spectrophotometry: Beer-Lambert's law, visible absorption spectrum, molar extinction coefficient, colorimeter, spectrophotometer, fluorescence, phosphorescence.

Centrifugation: Principle of sedimentation technique, different types of centrifuge and rotors, principle and procedure and application of differential centrifugation, density gradient centrifugation, ultra centrifugation rate zonal centrifugation, Isopycnic centrifugation

pH meter: Principle and working.

Brief account of densitometry, fluorimetry, manometry, polarography, atomic absorption spectroscopy, IR, NMR and X-ray crystallography and Mass spectrometry.

Electrophoresis: Principle, procedure and application of zone electrophoresis-, paper electrophoresis, gel electrophoresis (native PAGE, SDS-PAGE).

Isotopes and radioisotopes:

Isotopes and radioisotopes: radiations- ionizing radiations, Application of isotopes and radioisotopes in biological research, radioisotope tracer technique and autoradiography.

Module II

Biochemistry & Enzymology **Marks: 2**

Normality, molality, molarity, percentage solution, mole fraction, parts per million, simple numerical problems from the above, fundamental principles of diffusion, osmosis, osmotic pressure, carbohydrates, lipids, aminoacids, proteins, nucleic acids – their detection methods, Enzymes- Classification and nomenclature, enzyme activation, enzyme inhibition- competitive and non-competitive, allosteric regulation, purification of enzymes, coenzymes.

Module III

Microbiology **Marks: 3**

Bacteria, virus, fungi, protozoa, mycoplasma, concept of microbial species, strains; microbial cell surfaces, Gram positive and Gram negative bacteria, Motility in bacteria, kinds of flagella, Nutrition of Bacteria and Fungi, nutritional classification of bacteria.

Microbial Diversity: Bacterial population of Air, Water and Soil

Viruses: Viruses, phage culture, Bacteriophage, DNA and RNA phages, T4 phage, Llytic and

lysogenic cycles, host cell adsorption and penetration, synthesis phage nucleic acid.

Microbes in extreme environments

Thermophiles and alkalophiles, pathogenic microorganisms- bacteria, fungi, viruses, protozoans and mycoplasma, defense mechanism against microorganisms, symbiosis and antibiosis among microbial population, nitrogène fixing bacteria in agriculture and forestry, photosynthetic bacteria, Role of bacteria in carbon, nitrogen, sulphur and phosphorous cycle in nature.

Cultivation of Bacteria

Culture media – requirements of bacterial culture media, types and uses, Bacterial growth curve, microbial metabolism, fermentation, different types of fermentation, methanogenic bacteria.

Isolation of pure culture: Spread plate, streak plate, pour plate etc., synthetic media, simple and complex media. Isolation of anaerobes and its culture techniques, slant culture and stab culture.

Pollution and Microbial population, detection and isolation of bacteria and Fungus from environment; Environmental monitoring of microbial load of waste water, waste water treatment and purification of water, BOD and COD as microbial load of waste water.

Detoxification of polluted water with microbial treatment and Microbial analysis of portable water.

Industrial microbes and their uses

Production of food (dairy and SCP) and drugs (antibiotics such as penicillin & streptomycin), products of fermentation, Strain improvement by enrichment mutation and recombinant DNA technique, production of heterologous proteins of interest in microorganisms.

Microbes of Dairy and food Industry, Food preservation and processing of food,

Control of microorganisms

Physical agents, chemical agents, antibiotics and other therapeutic agents

Bacterial cell structure and Growth – Eukaryotic cells and prokaryotic cells, Glycocalyx, bacterial cell membranes, bacterial cell wall, cytoplasm, spores, organs of locomotion, chemotaxis in bacteria, ribosomes in bacteria, bacterial nucleus and chromosomes, bacterial nucleoid. Bacterial Growth curve, Measurement of growth, factors affecting growth of bacteria.

Nutrition in bacteria-classification based on nutrition- autotrophic and heterotrophic organisms, Photosynthetic and chemosynthetic organisms- purple sulfur bacteria, Saprophytes and parasites-pathogenic parasites.

Nitrogen Metabolism- Biological nitrogen fixation, symbiotic nitrogen fixation, components involved in the process of nitrogen fixation, Inorganic nitrogen metabolism, assimilation of inorganic nitrogen, Nitrogen cycle.

Energy production in bacteria- Energy and ATP, aerobic respiration, Glycolysis and tricarboxylic acid cycle, Electron transport and oxidative phosphorylation in Bacteria, catabolism of other carbohydrates.Photosynthesis in bacteria

Anaerobic respiration- Fermentation, alcohol fermentation by yeasts and bacteria, lactic acid fermentation, Methnogenic bacteria, Acetobacter and acetic acid fermentation.

Application of bacterial metabolism in industry and agriculture, economically important bacteria – lactic acid bacteria, nitrogen fixing bacteria etc.

Lichens, mycorrhizae, pollution indicators etc.

Microbial Diseases of Humans

Airborne bacterial diseases – streptococcal; diseases, tuberculosis, Pneumococcal Pneumonia, *Klebsiella* Pneumonia,

Foodborne and waterborne bacterial diseases- Foodborne and waterborne intoxications-Botulism, Staphylococcal food poisoning; Foodborne and waterborne infections- Typhoid fever, salmonellosis, Cholera, Shigellosis, *E.coli* Diarrheas, Brucellosis

Soilborne bacterial diseases- Anthrax, Tetanus, Leptospirosis,

Viral diseases of Humans- Pneumotropic viral diseases-Influenza, Adenoviral infections,

Rhinoviral infections,

Dermatoviral diseases- Herpes simplex, chickenpox, Measles, Rubella,

Viscerotropic Viral diseases- yellow fever, Dengue fever,

Neurotropic viral diseases- rabies, Polio

Module IV

Molecular Biology **Marks: 2**

Introduction

DNA, replication of DNA, RNA, Types of RNA. Transcription, translation, transcriptional and translational modifications, ORF, Eukaryotic and prokaryotic differences in the genetic makeup and processing, genes, transposons, mutations and repair of nucleic acids,

Gene and gene regulation – transcription and translation, Protein synthesis and Protein trafficking.

Transfer of genetic information in bacteria, Bacterial chromosomes- DNA, Plasmids, different types of plasmids- non-conjugative, mobilizable plasmids, resistance plasmids

Bacterial recombination:Conjugation- Fertility factors, F+ and F- cells, F pili, High frequency recombination, Transformation- Griffith's effect, evidence of DNA as genetic material, , Transduction- general characteristics of bacteriophages, Lambda pahage-general structure, general multiplication in bacteria- lytic phase and lysogenic phase, bacterial recombination through transduction, Phages and plasmids as vectors for genetic engineering, Bacterial recombination and transferable drug resistance.

Module V

Immunology & Immunotechnology **Marks: 2**

The Human Immune System: Organs and cells of immune system
Immune system and immunity, innate and specific or acquired immunity,

Immune system- organs, tissues and cells involved in immunity, Humoral immunity and cell mediated immunity, antigens, antibodies, immunogens, haptens.Immunoglobulins, structure and functions, Antibody-antigen interaction, antigen-antibody reactions, agglutination, immuno-diffusion, immuno-electrophoresis, ELISA, RIE, production of polyclonal and monoclonal antibodies, hybridoma technolog, Immunity to infections of diseases: vaccines - attenuated and recombinant vaccines, vaccination.therapeutic antibodies

Autoimmunity and autoimmune diseases: Hashimoto's thyroiditis; Myasthenia gravis; Rheumatoid Arthritis, Pernicious anemia, Asthma.

Module VI

Recombinant DNA Technology **Marks: 2**

Tools of recombinant DNA technology-

Restriction endonucleases, classification and general characteristics of endonucleases; other enzymes used in the recombinant DNA technique- DNA ligase, alkaline phosphatase;

Vectors, the vehicle for cloning: special features needed for a vector, Various types of cloning vectors- plasmid cloning vectors- pBR322, Expression vectors, the pUC series,Bacteriophage cloning vectors -phage ✧ cloning vectors, M13 based vectors,

Phagemids and Cosmid vectors, Artificial Chromosomes: Yeast Artificial vectors (YACs), Bacterial artificial Vectors (BACs), Application for YAC and BAC,- genome sequencing

Shuttle vectors for animals and plants, mammalian vectors; Gene Therapy- Vectors for gene therapy.

Construction of recombinant DNA, host cells, competent cells, bacterial transformation, screening methods of transformed cells, Various methods of genetic transformation in eukaryotes- Direct gene transfer and vector mediated gene transfer, Screening methods of transformed cells and organisms.

Molecular hybridization techniques for genome analysis Genome analysis: RFLP, AFLP, RAPD, Southern hybridization PCR: Principle and applications, Nucleic acid sequencing: Principle and applications, Genome sequencing methods, Human genome project– a brief account.Gene expression analysis – Northern hybridization and microarrays. Transgenic organisms and its impact in agriculture, Medicine and Environment, Biosafety and Ethics in Genetic Engineering.

Module VII

Industrial and Food Biotechnology **Marks: 4**

Industrial Microbiology
Microbes in industry- Industrially important microorganisms, screening and isolation, industrially important enzymes and chemicals, Industrial production of enzymes and chemicals, Microbial production of antibiotics, vitamins, amino acids and other organic acids

Fermentation
The biological process of fermentation- various types of fermentation, alcohol fermentation, Respiration vs Fermentation – Important products of fermentation**.** Fermentation as an industry, selection of industrial microorganisms for specific products and reactions,
Laboratory scale biological process- scale up of biological reactions in to bioprocess;
Bioreactors-types of bioreactors / Fermentors, Bioreactors for bacteria and yeast cells, Fermentors for plant cell cultures and animal cell cultures,

Microbes of food and fermented food- Curd, wheat and rice flour, Meat and fish, Poultry and Eggs, Breads and bakery products, Grains, Microorganism in food spoilage, types of spoilage, canning, microbes in the spoilage of canned foods, principles of preservation of foods, Hazardous effect of food spoilage, mycotoxins;

Industrial production of antibiotics (penicillin & streptomycin) and organic acids (acetic acid & Citric acids)

Microorganisms as food and food supplements – fermented food, microalgae- Single cell protein, Edible mushrooms. Microbes in dairy industry, dairy products; microbial processing of foods- enzymes in food processing.

Agricultural waste and food industry wastes as the substrate for fermentation, solid state fermentation; production of single cell proteins, microbial production of enzymes;
Microbiome and its importance disease prevention maintenance of health, Probiotics various types of probiotics and its importance.

Module VIII

Environmental Biotechnology **Marks: 4**

Ecosystem, Biodiversity, Types of ecosystem and biosphere;
Pollution: sources of pollution, Greenhouse effect, general characteristics of domestic wastes, community wastes, agricultural wastes, effect of solid waste in the environment
Types of pollution, Organic load in aquatic systems, BOD and COD, microbial quality of water, drinks and food Use of biotechnology in the treatment of municipal wastes and hazardous industrial effluents

Bioremediation: Microbial degradation of pesticides, herbicides and other toxic chemicals in the environment, Biological control of pests and insects, Biopesticides- *Bacillus thuringiensis*, bioherbicides; Plants used in metal remediation, plants and algae used in phytoremediation and their mechanisms

Application of biotechnology in the production of biofertilizers and nitrogen fixation – nitrogen fixing microorganisms, mycorrhiza

Renewable and non-renewable energy resources: conventional fuels and their environmental impacts (fire word, animal oils, coal, petroleum)
Non-conventionnel Energy Sources

Biomass: utilization of biomass as energy source– application of microbes in production of fuels from biomass- biogas and methanogenic bacteria, microbial hydrogen production, production of methanol, ethanol and other types of chemicals from biomass and agricultural wastes, the gasohol experiment

Solar energy converter, hopes from photosynthetic pigments, vegetable oils as engine fuels, energy crops-jojoba;

Possibility of plant-based petroleum industry and cellulose degradation for combustible fuels

Bioleaching

Enrichment of ores by microorganisms (bioaccumulation and biomineralization);

Bio-assessment of environmental quality.

Module IX

Plant and Animal Biotechnology **Marks: 2**

Plant tissue culture

Fundamental principles of *in vitro* plant cultures: use of plant growth regulators, composition of tissue culture media- media components and its functions.Types of *in vitro* cultures

Callus cultures, cell suspension cultures, organ cultures- root cultures, hairy root cultures, embryo cultures, anther culture ; their applications,

Genetic engineering of plants

Methods of gene transfer in plants –Physical, chemical and biological methods

Agrobacterium tumefaciens, tumor formation in plants by *A. tumefaciens*, application of *A. tumefaciens* in plant genetic engineering, Virus mediated gene transfer in plants.

Transgenic plants

Transgenic crops, Impact of transgenic plants in agriculture and Horticulture, Non-Agricultural applications of transgenic plants- Biopharming- production of therapeutic proteins in transgenic plants, edible vaccines, disease resistant, salt tolerant, pest resistant and stress tolerant crop and medicinal plants, Metabolic engineering of plants for enhanced and controlled production of plant products.

Application of Animal Cell Cultures

Uses of animal cell cultures, Products of animal cell cultures- hormones (insulin, growth hormones), interferon,t-plasminogen activator, factorVIII, Factor IX and virus cultivation;

Expression of cloned proteins in animal cells, production of vaccines in animal cells, production of polyclonal and monoclonal antibodies-hybridoma technology

Transgenic animals and its practical uses

Module X

Bioinformatics **Marks : 1**

Databases-various types of databases, Biological Databases- Importance of databases in technology, NCBI, Gene bank, PubMed. Etc.

Genomics and Proteomics-Definitions, Application of Proteomics and genomics in Biotechnology

Part III : CHEMISTRY (25 marks)

- **Quantum mechanics and Chemical bonding**

Heisenberg's uncertainty principle, Schrodinger wave equation, postulates of quantum mechanics, Wave function, Translational motion, Vibrational motion, Rotational motion, hydrogrn atom, Shapes of orbitals, Molecular orbital theory, Basis set, STO , GTO, Hybridisation, Spectroscopic terms, **2 marks**

- **Coordination Chemistry**

Charge transfer spectra, Term symbols, electronic spectra of complexes, Orgel diagrams, Tanabe-Sugano diagram, Magnetic properties of complexes, Magnetic moment and Applications of coordination complexes **2 marks**

- **Analytical Chemistry**

Titrametric, gravimetric and colorimetric analysis, Errors- Types of errors, accuracy and precision.

Spectroscopic methods - UV-Visible, IR, NMR and Mass spectroscopy.

Separation techniques- Solvent extraction, Extraction of metal ions and organic species from aqueous solutions, Chromatography

Instrumental techniques- Principle and application of Thermogravimetric analysis, Differential thermal analysis, AAS, X-ray fluorescence, and gas chromatography

5 marks

- **Colloids and Surface chemistry**

Colloids- Classification, Properties of colloids, zeta potential, Methods of molecular mass determination , Surfactants, Micelle formation, CMC, Emulsification,

Adsorption- Applications, adsorption isotherms- Freundlich, Langmuir, BET and Gibbs adsorption isotherms. Measurement of surface area, Adsorption behaviour of porous materials-theory of surface reactions- molecular sieves, -Micro pore analysis- morphology and particle size analysis- SEM, TEM, AFM and HR-TEM analysis

3 marks

Green chemistry

Need of green chemistry, Principles of green chemistry, Green solvents, Microwave and ultrasound assisted reactions, enzymes as catalysts **3 marks**

- **Environmental chemistry**

Environmental segments, oxygen cycle, Nitrogen cycle, hydrological cycle, Toxic chemicals in environment, Green house effect

Air pollution –Air pollutants, Green house effect, Global warming, Ozone depletion, Effect of hydrocarbons, smoke and oxides of nitrogen, sulphur and carbon on human and plant systems, Control methods of air pollution.

Soil pollution- Soil formation, soil acidification, liming of soil, Industrial and urban wastes, Land fills, control of soil pollution

Water pollution- Sources, Eutrophication, DO, BOD, COD, water quality criteria for domestic and industrial uses, Water quality parameters and their determination, , Sewage treatment, Principle and methods of waste water management .Removal of organic and inorganic matter from water. International standards for drinking water.

Thermal and radioactive pollution:-Sources and control of radioactive pollution and thermal pollution, Effects of radioactive pollution. Biological effects of radiation, Radioactive waste management.

Noise pollution- Noise - general features, control of noise pollution.

Chemical toxicology - Toxic chemicals in the environment, Effects of toxic chemicals, Pesticides, fertilizers and their biochemical effects. **10marks**

Part IV : Environmental Science / Life Science (25 Marks)

Module 1 (5 marks)

Classification of elements, Stoichiometry, Gibbs' energy, chemical potential, chemical kinetics, chemical equilibria, solubility of gases in water, the carbonate system, unsaturated and saturated hydrocarbons, radioisotopes. Dissociation of water, ionic products of water, concept of pH and pOH, redox potential, types of acids, bases, buffers and electrolytes. Dissociation of weak acids and electrolytes. Meaning pKa values, buffers and mechanism of action. Handerson Hassel's baach equation. Molecular interactions. Non covalent interactions and covalent interactions with examples. Meaning of normality, molality and molarity. Percentage solutions and mole fractions. Simple numerical values from the above. Laws of thermodynamics, heat transfer processes, mass and energy transfer across various interfaces, material balance. Principles of diffusion and osmosis, definition of osmotic pressure. Sedimentation, coagulation, flocculation, filtration, Influence of ionization and molecular size on osmotic pressure. Isotonic, hypertonic and hypotonic solutions-definition and examples. Meaning of true solutions, colloidal solution and coarse suspension. The distinction between lyophilic and lyophobic salts with examples. Elementary study of charge on colloids, Tyndall effect. Emulsions and emulsifying agents and examples. Reverse osmosis and its applications. Isomerism- stereo isomerism, optical isomerism.

Module 2 (5 marks)

Biomolecules-carbohydrates, lipids, proteins, nucleic acids, amino acids, fatty acids, nucleotides classification with examples. Basic structure of proteins, carbohydrates and nucleic acids. Enzymes-properties, factors affecting its action, basic mechanism of action. Name of methods for the detection of carbohydrates, amino acids and proteins in a solution. Denaturation of proteins and DNA. Precipitation reactions of proteins. Polymers. Natural polymers, semisynthetic polymers, synthetic polymers, definition and examples. Examples for addition polymers, condensation polymers, elastomers, thermoplastic polymers, thermo setting polymers. Difference between natural and synthetic rubber. Biodegradable polymers. Biodegradable plastics-polyhydroxy alkanoates and polyhydroxy butyrates. Detoxification of toxic chemicals in the human body- site and basic mechanism. Biochemical effects of heavy metals on the human body.

Module 3 (5 marks)

Common microbes in soil, water and air and their importance. Methods of microbial control. Physical and chemical methods with examples and their mechanism of action. Preparation of different culture media. Preparation of slants, butts and plates. Use of differential and selective media with examples. Inoculation techniques and study of growth. Identification of gram positive and negative bacteria. Microbiological analysis of water purity, indicator organisms, ground water quality and domestic water treatment systems. Biofilms, microbial mats, water and disease transmission. Microbial diversity in soil. Biogeochemical role of soil microorganisms. Distribution and sources of air borne organisms. Droplet and droplet nuclei. Examples of food borne microbial diseases. Food adulterants, artificial sweeteners, artificial colours, artificial flavours. Common microbial toxins and fungal toxins in stale food. Importance of biotechnology in industrial pollution control-paper industry, textile industry, petrochemical industries and mining industries. Municipal solid waste management, role of composting and vermi composting. Disposal of solid wastes- sanitary land filling and its management, incineration of solid wastes. E wastes- classification and method of handling and disposal. Fly ash- sources, composition and utilization. Plastic wastes- sources, consequences and management. Environmental disasters- Meenamatha disaster, Love canal disaster, Bhopal gas disaster, Chernobyl disaster, Fukushima Daiichi nuclear disaster. Epidemiological issues like fluorosis, arsenicosis,

Module 4 (6 marks)

Concept of ecotone, edge effects, ecological habitats and niche. Ecosystem stability and factors affecting stability. Composition of air. Particles, ions and radicals in the atmosphere. Chemical speciation. Chemical processes in the formation of inorganic and organic particulate matters, thermochemical and photochemical reactions in the atmosphere, Oxygen and Ozone chemistry. Photochemical smog, particulate air pollutants. Smoke, dust, mist, fumes and their sources. Smog, classical and photochemical smog with examples and their effects and control measures. Global warming and green house effect, acid rain, ozone hole. Assessment of air quality, air sanitation. Examples of air borne microbial diseases. Water pollution- Organic wastes, in water, chemical pollutants, heavy metal pollutants. Water analysis for chemical detection. Eutrophication. Biosensors for environmental monitoring. Soil pollution- Pesticides and its types, herbicides and its types, industrial wastes, biodegradable and non biodegradable, with examples. Biodegradation of herbicides and pesticides. Bioinsecticide use. Radioactive wastes-sources and management. Measurement of the level of pollution- Chemical oxygen demand. Suspended solids. Biological oxygen demand. Ammoniacal nitrogen content and biological indicators. Biological magnification. Sources and effects of noise pollution. Noise standards. Environmental education, major conservation efforts of World Wildlife Fund,

International Union for Conservation of Nature (IUCN), United Nations Environment Programme (UNEP), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and Environmental Information System (ENVIS).

Module 5 (4 marks)

Microscopy- basic principle and technique of compound and electron microscope. Principle, basic technique and uses of photoelectric colorimeter and spectrophotometer. Basic techniques and application of chromatography, paper, thin layer, gel, gas, high pressure liquid chromatography. Principle and basic technique of electrophoresis like gel electrophoresis and poly acrylamide electrophoresis. Basic technique of recombinant DNA technology and its applications. Basics of blotting techniques and its application. Basic principles of PCR and its applications. NMR technique, Mass spectroscopy, Measurement of radioactivity- Geiger- Muller and Scintillation counters, autoradiography and its applications. Biotechnological management of solid and liquid wastes. Uses of immobilized enzymes with examples. Genetic engineering- Importance in pollution control. Bioremediation, biosorption techniques to control pollution.

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper