**Tamil Nadu Public Service Commission**
**Syllabus**
**Environmental Science, Biology and Chemistry**
**(PG Degree Standard)**

**Code: 557**

**Unit I: Introduction to Environment (30 Questions)**

Environment: Components – Segments – Atmosphere: Troposphere – Stratosphere – Mesosphere – Thermosphere – Lithosphere: Crust – Mantle – Core – Hydrosphere: Fresh water and saline water - Biosphere – Ecology: Autecology – Synecology – Ecosystem: Structure and Function – Energy Flow – Food Chain – Food web – Ecological pyramids – Biogeochemical cycles (C,N, P, S and water) - Ecological successions: Primary and Secondary succession – Ecological interactions: Symbiosis - Commensalism – Mutualism - Proto-cooperation – Amensalism – Predation – Parasitism – Natural resources: Classification- renewable and non-renewable - Status and challenges. Water resources: Types – Availability – Issues -Conflicts over water. Soil and mineral resources - Mineral exploitation and Environmental impacts; Forest resources. Energy resources: Conventional and Non-conventional energy - Sustainable development: Sustainable Development Goals (SDGs)

**Unit II: Environmental Pollution and Management (30 Questions)**

Pollution – Pollutant – Contamination – Contaminant - Point and non-point sources. Air pollution: Sources - Primary and secondary pollutants - Criteria pollutants – VOCs – PAN - PAHs - POPs - Acid rain – Smog – Oxidizing - Reducing. Air Pollution dispersion models: Looping – Coning – Lofting – Trapping - Indoor air pollution –Effects. Control Measures: Scrubbers – Wet – Dry – Venturi – Filter – Bag filters – Dehumidifier- Electrostatic precipitators (ESP) – Flue Gas Desulfurization (FGD). Cyclonic separators – Catalytic converter. Noise pollution: Sources – Effects – Control measures. Water pollution: Sources – Effects – Eutrophication – Biomagnification – Bioaccumulation – Control Measure – Waste water treatments – Primary – Secondary –Tertiary – Common Effluent Treatment Plant (CETP) – Sewage Treatment Plant (STP) – Constructed Wetlands. Soil pollution: Sources – Effects – Control measure – Bioremediation – Microbial remediation – Phytoremediation - Heavy Metal Pollution – Hg - Cr – As – Se – Cd - Pb - Sources – Effects - Thermal and Radioactive pollution - Municipal solid waste - Hazardous waste – Biomedical waste – Effects - Control measures – Incineration – Pyrolysis - Gasification – Composting – Ecotoxicology: Toxicant – Toxicity – Acute – Subacute – Chronic - Dose descriptor – LD50 – LC50 – NOAEL- Dose response relationship- Fate of Chemical in environment: Insecticides Fungicides – Herbicides – Fertilizers – PCB - Dioxins. Land degradation- deforestation- desertification – urbanization- Ozone layer depletion – Greenhouse Gases and Climate change – Meteorological indicators - Remote Sensing and GIS for environmental Management – National river conservation plan – Carbon sequestration and carbon credits.

**Unit III: Environmental Legislation, Policies and Standards (25 Questions)**

Introduction to environmental laws - Constitutional provisions- Article 48A, Article 51A (g) – Article 21- Major Indian Environmental Legislations: Water Act - Air Act - Environment Protection Act – Environmental Protection Rules - Noise Pollution Rules – Biodiversity Act - Plastic and Solid waste management Rules – National Green Tribunal Act – Bio Medical Waste Management Rules – The E- Waste Management Rules – Hazardous and Other Wastes(Management and Transboundary Movement) Rules- Environmental Impact Assessment Notification – Coastal Regulation Zone Notification. Central Pollution Control Board (CPCB) - Environmental standards – Drinking water standards (IS 10500:2012)- Discharge of Industrial

Effluents into inland – Public sewers – Irrigation – Marine – Standards for sewage treatment plants – Designated best use water quality criteria. National Ambient Air Quality standards – Noise standards - National Green Tribunal – Environmental Impact Assessment: Screening-Scoping- Public consultation – Methodologies – Environmental management plan- ISO 14000 series – Life cycle assessment – Occupational health and safety: Preventive measures – Health screening measures.

**Unit IV: Instrumentation and It's Applications (30 Questions)**

Basic Principles, Instrumentation and applications of Ultraviolet-visible (UV-vis.) spectroscopy; Beer-Lambert's law, solution preparation and small molecules analysis and Flow Injection analyzer - Fourier Transformer Infrared spectroscopy (FT-IR): sample preparation - functional group analysis, Flame spectrometry, Atomic Absorption Spectroscopy (AAS), Inductively Coupled Plasma - Mass Spectrometry (ICP-MS), Inductively Coupled Plasma Emission spectroscopy (ICP-OES), Fluorimetry – Chemiluminescence's Detector system, X-ray fluorescence spectroscopy (XFS), Microscopy techniques: (fundamentals only) Optical microscopy, Scanning Electron Microscopy (SEM). Transmission Electron Microscopy (TEM).

Chromatographic Techniques: Basic Principles, Instrumentation and applications of chromatography – Paper chromatography, Thin layer chromatography (TLC), High-performance Liquid chromatography (HPLC) and Gas chromatography (GC), Gas-Chromatography with Mass Spectrometry (GC-MS).

Electrochemical Techniques: Basic Principles, Instrumentation and application of conductometry, potentiometry – Ion selective meter – Voltammetry – Turbidimetry and nephelometry, Elemental analyzer, TOC analyzer, Portable Gas analysis, ambient air quality $H_2S$, $CO_2$, $SO_2$, $NO_2$, $NH_3$, $O_3$, HC Particulate analysis, Stack monitoring, Volatile organic Carbon (VOC).

**Unit V: Analytical chemistry (30 Questions)**

Titrimetric Analysis: Classification of reaction in titrimetric analysis – Standard Solutions – Normality, Molarity and Molality - concentration units – Primary and Secondary standard – neutralization indicators – self indicators and external indicators- acid base titrations – precipitation titrations – redox titrations.

Principles of gravimetric analysis – choice of precipitants and condition of precipitation, specific and selective precipitants – Dimethyl glyoxime (DMG), cupferron, phenolphthalein, salicylaldehyde, ethylene diamine – Co-precipitation and post precipitation.

Sampling techniques and procedure for solids, effluent, water and air - Physical evaluation of water; color, odour and turbidity. Chemical examination of water; alkalinity, Total Dissolved Solids (TDS), turbidity and total hardness. Determination of carbonates, bicarbonates, sulphates, chlorides, nitrates, phosphate, fluorides – sodium, potassium, SAR, iron, manganese, cadmium, chromium, lead, mercury and arsenic – oil and grease. Biological evaluation of water; dissolved oxygen, biological oxygen demand, chemical oxygen demand - organic pollutant and microbiological analysis.

**Unit VI: Environmental Biology (10 Questions)**

Physiology: Water relations of plants, Ion Transport, photosynthesis, Photolysis of water, Carbon fixation in C3-C4 cycles, Biological Nitrogen fixation, Stress physiology (Biotic and Abiotic), Photochemical reactions, Oxidative Phosphorylation. Biodiversity - Biodiversity and its distribution; Levels and types; Hotspots; Biodiversity loss - Threats to biodiversity - In-situ and

ex-situ conservation approaches - Biosphere reserves – MAB program - Pollution indicator organisms and adaptive mechanisms in invertebrates, fishes, amphibians, reptiles and birds. Biophysics: Laws of Thermodynamics, Energy transduction in biological systems. Migration of fishes, birds and mammals. Endangered and extinct species - current status – IUCN Red list category.

**Unit VII: Biochemistry Aspects of Pollution (10 Questions)**

Introduction to Pollution and Biochemistry: Disruption of Biochemical Pathways by Pollutants. Carcinogens and Environmental Pollution: Definition and Types of Carcinogens, Mechanisms of Carcinogenesis - Oxidative Stress, Common Environmental Carcinogens. Biochemical Markers for Carcinogenesis: Asbestos Toxicity - Heavy metal toxicity: Lead, Cadmium, Mercury, Arsenic and their Biochemical Effects - Mechanisms of Toxicity: Free Radicals, Oxidative Stress, Antioxidants. Role of Blood Tests in Detecting Pollutant Exposure: Effect of pollutants on human health. Pathways for Detoxification: Phase I and Phase II Detoxification.

**Unit VIII: Environmental Microbiology (15 Questions)**

Environmentally transmitted Microbial Pathogens *(Mycobacterium tuberculosis, Streptococcus pyogenes, Salmonella typhi, E.coli, Vibrio cholerae, Clostridium botulinum),* Viruses (Enteric and Respiratory), Indicator Microorganisms – Total and Faecal Coliforms, Faecal Streptococci. Biofouling and Biofilms; Microbial toxicants (Tetanus toxin, Botulinum toxin), Aflatoxin, Waste water treatment (Aerobic and anaerobic) – Waste conversion using microorganisms - Biofertilizer – Important plant diseases caused by Bacteria, Mycoplasma, Virus, Fungi and Nematodes – Biocontrol agents – Integrated pest management. Microbial Biotechnology – Fermentation technology – fermentation as a biochemical process – Bioconversion: Production of Alcoholic beverages, Antibiotics, Amino acids, Vitamins and Organic Acids – Single Cell Protein production (SCP).

**Unit IX: Marine Environment (15 Questions)**

Fundamentals of marine biology: Physical chemical properties of seawater-Chemical Properties-Vertical stratification- horizontal stratification of marine ecosystem-Marine Ecosystems: coastal; pelagic; and estuaries; deep sea; coral reefs; mangroves; sea grass meadows. Microorganisms; invertebrates; vertebrates; marine plants; Turtles seabirds and marine mammals. Marine protected areas; conservation strategies; IUCN categories. Human Impacts, disaster and its management: sea ranching; Artificial reef. Marine Pollution and management: point and non-point source pollution; oil pollution; plastic pollution; microplastic pollution; heavy metal pollution; nutrient pollution, pesticide pollution; PHC pollutions, thermal pollution, nuclear pollution ballast waters and its impact.

**Unit X: Biostatistics (5 Questions)**

Biostatistics: Sampling techniques, Central Values (Mean, Mode, Median), Dispersion: absolute relative probability: Binomial Properties, Problems, Fitting Positions, Normal, Skewness, Kurtosis, Correlations and Regressions - Simple Linear Testing – large sample. T-test, Chi square Test – Two-way ANOVA Experimental Design – Principles. CRD, RBD, LSD, Missing Plots – Figurative Representation (Bar diagram, Pie chart etc).

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