Himachal Pradesh
Public Service Commission

No.9-21/2022-PSC (R-IV) **Dated: 28.03.2024**

Syllabus for Paper-II i.e. Descriptive Type Subject Aptitude Test (SAT) for the recruitment to post of Scientific Officer, Class-I (on contract basis) in H.P. State Pollution Control Board under the Department of Environmental, Science & Technology, H.P. The SAT will be of 03 hours duration having 120 marks and will comprise of two parts as follows:-

A. Common Syllabus **(60 Marks)**

Definition and sources of pollution, Different types of pollution, Environmental segments. Composition of the atmosphere, Chemical composition of Air, Chemical and photochemical reactions in the atmosphere,Types and sources of water, air & soil pollution, Oxides of C,N,S and their effects on flora and fauna, Acid-rain, Photochemical smog formation, Green house effects (global warming and ozone depletion),Introduction to analytical methods for monitoring and analysis of water, air and soil pollution, Noisepollution, Soil composition, Physical and chemical characteristics, Micro and macro nutrients, Soilpollution-fertilizers and pesticides, Bio-remediation and bio-restoration of contaminated soils.

Hydrological cycle, Water pollution: inorganic, organic, pesticides, industrial and radioactive materials, oilspills and oil pollutants, Eutrophication and its impact on organisms and communities, Impact of heavy metals, halogens, radio-nucleotides on aquatic flora and fauna, Aerobic treatment of waste water (Trickling Filters, Rotating Biological Contractors, Fluidized bed reactors, Packed bed reactors), Anaerobic Baffled Digesters, Up flow Anaerobic Sludge blanket reactors, and Industrial waste water treatment, Advanced waste water treatment for removal of major pollutants, Emerging biotechnological and Nano-technological processes in waste water treatment.

Chemical kinetics, Alcohols, Phenols, Ether, Aldehydes and Ketones, Basic principles of thermo dynamics,Chemical & lonic Equilibrium, Solutions and Electrochemistry, Carbohydrates, Periodic properties of elements, Acid and Bases, Basic concepts of organic reactions, Redox Reactions.

Basic Principles of spectroscopy, Principle, working and applications of UV, Visible IR, H-NMR for the determination of structure of simple organic compounds, Spectrophotometer, Flame Photometer, Atomic Absorption Spectrophotometer, GC, GC-MS, HPLC, Chromatography (Paper, TLC, Gel Filtration Ion-exchange Chromatography, Reverse phase

chromatography, Hydrophobic interactions, Affinity chromatography, X-ray Diffraction, Microscopy, Electron Microscopy: SEM, TEM, AFM, Electrophoresis, Centrifugation.

Statistical analysis of data, Types and source of errors, Propagation of errors, Detection and minimization of various types of errors, Uncertainty, Accuracy and precision, Average and standard deviation, Variance and confidence interval, Tests of significance (F-test, t-test and paired t-test), Criteria for the rejection of analytical data (4d rule, 2.5 d rule, Q-test, average deviation and standard deviation), Least-square analysis.

Overview of metabolic processes (catabolic and anabolic), Energy transfer processes, Role andsignificance of ATP (the biological energy currency), Glycolysis, TCA Cycle, Pentose Phosphate Pathway, Gluco-genesis, ETC and oxidative phosphorylation, Metabolism of proteins and lipids, their structure, nomenclature and properties, Biosynthesis of proteins and glycerides, Acyl-glycerol, Phospho-glycerides, Sphingolipids, Glycosphingolipids Catabolism of fatty acids.

Amino acids as building block of proteins, their structure and classification and chemical properties, Simplepeptides, Structure of peptide bond, Organizational levels of protein structure, Properties of proteins:simple, conjugated, fibrous and globular proteins, Purine and pyrimidine bases of nucleic acids, Basepairing via H-bonding. Structure of ribonucleic acids (RNA) and deoxyribonucleric acids (DNA), Doublehelix model of DNA and forces responsible for holding it, Chemical and enzymatic hydrolysis of nucleicacids, Replication of DNA, Transcription, Translation and genetic code, Chemical synthesis of mono andtri-nucleoside, Structure, Properties and classification of Porphyrins, Biosynthesis and degradationenzymes: nature, co-enzymes, cofactors and prosthetic groups, classification, factors affecting enzymeactivity.

B. Subject Specific Syllabus: (60 Marks)

B.1 Chemistry:

Molecular theory of hetero diatomic molecules, Band theory of bonding in metals, Hydrogen bonding, Solid state chemistry: radius ratio rule, Space lattice (only cubes), Type of unit cell, Bragg's Law, Calculation of density of unit cell, One and two Dimensional solids, Graphite as two dimensional solidand its conducting properties, Fullerene and its applications, Molecular structure and basic quantum chemistry, Schrodinger equation, Interpretation of wave function, Hydrogen atom, Atomic and molecular orbitals, Phase Rule, Equilibrium potential, Electrochemical cells (galvanic and concentration cells), Electrochemical theory of corrosion and protection of corrosion, Surfactants(cationic, anionic and non-ionic detergents), Polymers, Stability of reaction intermediates e.g. carbanions, carbocations and free radicals, Types of organic reactions and mechanism of nucleopile substitution reactions, Common organic

reactions and their mechanis, Stability of cycloalkanes, Resonance concept, Inductive and mesomeric effects, Directive effects, Activating and deactivatinggroup, Hydrogen bonding, Reagents in organic synthesis of selected organic name reactions and theirmechanisms, Nucleophilic substitution reaction, Eletrophilic and free radical addition reactions, Electrophilic aromatic substitutions reactions, Nucleophilic addition (principles of nucleophilic additionto carbonyl groups, reduction & oxidation), Elimination reactions, E-Z and R, S Nomenclature, Opticalisomerism of organic compounds containing one chiral centre, Examples of optically active compoundswithout chirality, Conformations of n-butane, Concept of aromaticity, properties of conjugated systems,Group theory, Non-aqueous solvents, Inorganic hydrides, Pericyclic reactions, green chemistry.

B.2 Environmental Science:-

Environmental geoscience and geology, Geomorphological processes, Environmental geochemistry, Concept and scope of ecology and biological diversity, Ecosystem concepts and dynamics, Study of different ecosystems, Environmental health, Biosphere and its evolution and major biomes in India, Biogeography, Advances in environmental biology, Status and distribution of wildlife in India, Air, water , soil and noise pollution, Thermal and radiation pollution, Concept of ecotoxicology and radiation impacts,Occupational health, safety & regulation, Effect of radiation at molecular level, Principles andapplications of green technology, Environmental Impact Assessment: methodology, prediction andassessment of impacts, public participation, Environmental management and ISO certification, Microwave sensing, Digital image processing and applications of remote sensing and GIS inenvironmental management, Radiation detectors and monitors, Judicial activism and environmental, protection, Environmental laws, policies and regulations, Environmental treaties and conventions, Natural resources-laws, conservation strategy and management,Disaster mitigation and management, Circular economy, Sustainable development. , Environment audit.

B.3 Microbiology:-

Scope and history of microbiology, Staining and microscopy, Laboratory techniques in microbiology, Evolutionary link of prokaryotes, Morphology and ultrastructure of bacteria, Microbial growth and reproduction, Sterilization techniques, Nutritional requirement of microbial growth, Microbial genetics, Genome of prokaryote Eukaryote (Fungi) and viruses, Genetic elements, Extra chromosomal DNA in bacteria and eukaryotic cells, Gene expression and regulation, Genetic recombination in bacteria, Gene sequencing, The nature of Genetic material, replication, History and scope of recombinant DNA technology, Cloning and expression vectors, DNA cloning strategies, Nucleic acid plotting and hybridization, Expression of clone genes, polymerase chain reaction and site directed mutagenesis, Nomenclature and classification of viruses, Bacterial viruses, Importance and significance of microorganism in food, Microbial spoilage of different types of foods, Fermentation and food

preservation methods, Food safety and quality management system, Microbial growth and physiology, Pathways and their significance, Growth kinetics and nutritional classification, Enzymes and microbial metabolism, Bio-synthesis of macromolecules, Microbial biotechnology, Fermentation metabolism, Fermenter/ bioreactor, Design and operation, Fermentation system, Recombinant products, Microbial conversion and their product formation.

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