FURTHER DETAILS REGARDING MAIN TOPICS OF PROGRAMME NO. 02/2017 (Item No. 13)

JUNIOR SCIENTIFIC OFFICER

CHEMICAL EXAMINERS LABORATORY

(CATEGORY No. 485/15)

BIOCHEMISTRY

MODULE – I : Biomolecules and Biochemical techniques

Overview of physical aspects in Biochemistry, Classification, Structure and functions of carbohydrates, Lipids, Proteins and nucleic acids. Methods for the isolation, purification and characterization of protein, denaturation of proteins and nucleic acid. Nucleic acid sequencing, proteome analysis.

Microscopy:- Basic principles, instrumentation and applications of microscopy. Bright field, phase-contrast, fluorescence and confocal microscopy. Electron microscope – scanning and transmission electron microscopy. Principle methodology and applications of different types of electrophoresis, blotting and PCR techniques.

MODULE – II : Nutrition and Biochemical basis of diseases.

Nutritional aspects of Carbohydrates, lipids, proteins and fiber Nutritional Value of vitamins, minerals – Physiological and Biochemical functions, Daily requirement, Protein energy malnutrition - Kwashiorkor, Marasmus- aetiology, metabolic disorders and management. Diseases related to digestion and absorption of food.

Composition of blood, Plasma Proteins, Formed elements – overview, Coagulation, Hemoglobin metabolism and Chemistry of Respiration, Abnormal Hemoglobin and their deficiencies, Renal Function, Liver and detoxification, Liver diseases, Renal function test, liver function test. Inborn errors of metabolism, Antibiotics – action of Penicillin, Streptomycin, Tetracyclin, Chlorophenicol, Rifampicin .

MODULE -III: Metabolism and Enzymology

Metabolism of carbohydrates -glycolysis, glycogen metabolism, citric acid cycle, Pentose Phosphate pathway, Gluconeogenesis, Bioenergetics – Ultrastucture of Mitochondria, electron transport chain, oxidative Phosphorylation, Metabolism of lipids – Fatty acid synthesis and degradation, Ketone, bodies, Cholesterol metabolism –

Eicosanoids, phospholipid metabolism, Metabolism of lipoproteins, Metabolism of amino acids and nucleic acids. Regulation of metabolic pathways. Associated metabolic disorders.

Nomenclature and classification of enzymes, isolation and purification of enzymes, Enzyme Kinetics, Enzyme inhibition, vitamins as coenzymes,. Active site, Mechanism of Enzyme action, Regulation of enzyme activity, Allosteric enzymes, Isoenzymes, Industrial and clinical applications of enzymes.

MODULE-IV: Molecular biology and immunology

Genetic information carriers-DNA replication(prokaryotes and eukaryotes) and Repair, Transcription and translation(prokaryotes and eukaryotes), post transcriptional processing, post translational modifications, types of RNA, genetic code, regulation of transcription and Translation, operons, gene silencing , micro RNA, epigenetics.

Overview of the Immune system, Cellular components of the immune system, Nature of Antigen and Antibody , Innate immunity, Soluble factors, Inflammation, Phagocytosis. Adaptive Immunity, Lymphocyte, T and B cell maturation, Clinical Immunology, Antigen – antibody interactions, Diagnostic techniques, Applications, Immunodeficiencies , Immuno therapy.

Syllabus: Chemistry

Unit I - Structural and Solid state Chemistry

Theories of Metal Complexes - LFT CFT, Spectral and Magnetic properties of transition metal complexes, Term symbols, Selection rules for electronic transition, Spin orbit coupling. Organometallic compounds- Isolobal analogy. Metal carbonyls, Complexes with linear π donor ligands, Olefins, acetylenes, dienes and allyl complexes. Complexes with cyclic π donors, Fluxionality. Interhalogens, Sulphur-Nitrogen compounds, Phosphazines and Boron compounds, Wade's Rule. Metallaboranes and metallacarboranes. Spectral and Magnetic properties of Lanthanides and Actinides, Shift Reagents.

Crystalline state - Crystal systems and lattice types, Bravais lattices. Crystal symmetry, Point groups and space groups. Miller indices, Reciprocal lattice concept, X-Ray diffraction by crystals, Structure factor, Fourier synthesis. Perosvskite, Spinels, Inverse spinel structures.

Solid state Chemistry- Superconductivity, Photoconductivity, Photovoltaic effect. Colour in inorganic solids. Dielectric properties- Ferroelectricity, pyroelectricity, piezoelectricity.

Unit II- Stereochemistry and Spectroscopy in Organic Compounds

Structure and Stereochemistry, Correlation of structure and reactivity, Aromaticity of annulenes, Non-benzenoid aromatics, Molecular chirality, Stereochemical nomenclature of compounds with chiral centres, axis and planes, Prostereoisomerism, Non-carbon chiral centres, Atropisomerism.

Reactions of sp^3, sp^2 Carbon and aromatic systems, Cram's rule. Felkin-Anh Model. Reactive Intermediates and Rearrangement Reactions.

Pericyclic Reactions, electrocyclic, cycloaddition and sigmatropic reactions, 1,3-dipolar cycloadditions, ene reactions, cheletropic reactions, Woodward-Hoffmann selection rules. Organic Photochemistry, Primary photoprocesses aromatic photo rearrangements. Chemi and bioluminescent reactions. Organic structure elucidation by spectroscopy- ^{1}H and ^{13}C NMR chemical shifts and coupling constants of organic compounds. UV-VIS spectra of enes, eneones, arenes and conjugated systems. Woodward-Fieser rules, Structural features by IR. Mass Spectroscopy in organic structure analysis

Unit II- Theoretical Chemistry and Kinetics

Quantum Mechanics- Wave functions, Concept of Commutators. Eigen function and eigen values, Tunnelling. Zero point energy and significance, Radial probability distribution function and graphs. Maxwell-Boltzman, Bose-Einstein and Fermi-Dirac statistics. Symmetry elements and symmetry operations- Point groups, Applications of character tables to spectroscopy.

Molecular Spectroscopy- Theory of Microwave spectroscopy, Infrared spectroscopy, Raman spectroscopy, Electronic spectroscopy, Resonance spectroscopy-NMR, ESR & Mossbauer.

Influence of temperature and pressure on transport properties, Mean free path, Collision diameter, Collision Theory. Activated complex theory. Order and molecularity of reactions. Steady state approximation. Kinetics of fast reactions, Relaxation spectrometry, Flash photolysis. Factors influencing reaction rates in solution. Catalysis-Mechanism and theories of homogeneous and heterogeneous catalysis.

Unit IV- Instrumentation methods in Chemical Analysis

Instrumentation and application of Radiation Analysis Methods- Detection counters. Geiger counter, scintillation counters, Neutron activation analysis. Isotope dilution methods. radioactive tracer techniques and its applications. Electroanalytical Methods- Principles, Instrumentation and applications of Electrogravimetry, Coulometry, Polarography, Amperometry, Cyclic voltametry, Potentiometry and Conductometry. Thermal and Surface Analysis Methods- Principles, instrumentation and applications of TG, DTG, DTA, DSC. Introduction to, SEM, TEM, AFM STM, and other surface characterization techniques.

Chromatographic Methods- Principles, instrumentation and applications of column chromatography, paper chromatography, thin layer chromatography, ion-exchange chromatography, gas chromatography and liquid chromatography. Hyphenated techniques,

Instrumentation of of UV-Visible Spectrometer, IR and Spectroflurometer, AAS, AES, , ICP AES, XPS Radiation Sources for UV Visible and Infrared Monochromators. Detectors-CCD, Photomultiplier Tube, Michelson Interferometer.