SYLLABUS FOR STREAM CHANGE / PRE GU-ART IN BIOCHEMISTRY

Note: Topic wise weightage of marks is given in bracket (weightage in terms of percentage).

Taxonomy, Cell Biology and Cell structure: (6%)

Five kingdom classification, Salient features and classification of Monera; Protista, Fungi, plantae and animalia, Importance of major groups: Lichens; Viruses and Viroids. Theory of Spontaneous generation vs. biogenesis

Cell theory and cell as the basic unit of life; Structure of prokaryotic and eukaryotic cell; Plant cell and animal cell; Cell envelope, cell membrane, cell wall; Cell organelles– structure and function;

Endomembrane system- endoplasmic reticulum, Golgi bodies, lysosomes, vacuoles; mitochondria, ribosomes, plastids, microbodies; Cytoskeleton, cilia, flagella, centrioles (ultra-structure and function); Nucleus–nuclear membrane, chromatin, nucleolus.

Chemical constituents of living cells: Biomolecules–structure and function of proteins, carbohydrates, lipid, nucleic acids; Enzymes–types, properties, enzyme action.
Cell division: Cell cycle, mitosis, meiosis and their significance.

Microbial cell organization, Microscopy and principles of staining (6%)

Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella, fimbriae and pili.

Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, Gram staining mechanism, lipopolysaccharide (LPS).
Cell Membrane: Structure, function and chemical composition of bacterial cellular membrane.
Endospore: Structure, formation, stages of sporulation

Bright Field Microscope, Dark field Microscopy, Phase contrast, SEM, TEM, mordants, fixatives and decolourisers, definition of dyes, chromogen, chromophore and auxochrome group, types of staining – Gram staining, monochrome staining and negative staining.

Plant Physiology, Photosynthesis and Respiration (10%)

Mineral nutrition: Essential minerals, macro and micronutrients and their role; Deficiency symptoms; Mineral toxicity; Nitrogen metabolism –Nitrogen cycle, biological nitrogen fixation

Photosynthesis as a means of Autotrophic nutrition; organelles and pigments involved in Photosynthesis; Cyclic and non-cyclic photophosphorylation; Chemiosmotic hypothesis; Photorespiration; C3 and C4 pathways.

Exchange of gases; Cellular respiration – glycolysis, fermentation (anaerobic), TCA cycle and electron transport system (aerobic); Energy relations – Number of ATP molecules generated; Amphibolic pathways; Respiratory quotient.
Plant Growth regulators–auxin, gibberellin, cytokinin, ethylene, ABA; Seed dormancy; Vernalisation; Photoperiodism.

Carbohydrates, Lipids, Proteins, Nucleic acids and Enzymes (16%)

Families of monosaccharides: aldoses and ketoses, trioses, tetroses, pentoses, and hexoses. Furanose and pyranose forms of glucose and fructose.
Disaccharides; concept of reducing and non-reducing sugars, Haworth projections of maltose,lactose and sucrose.
Polysaccharides, storage polysaccharides, starch and glycogen. Structural Polysaccharides, cellulose, peptidoglycan.
Definition and major classes of storage and structural lipids. Storage lipids. Fatty acids: structure and functions. Essential fatty acids. Triacyl glycerols structure, Structural lipids. Phosphoglycerides: Building blocks, General structure.
Amino acids, the building blocks of proteins. General formula of amino acid and concept of zwitterion. Protein structure: Primary, secondary, tertiary and quaternary structures.
Structure of nucleotides, DNA and RNA; brief concept of central dogma of molecular biology.
Classification of enzymes. Apoenzyme, coenzyme, prosthetic group, cofactors. Structure of enzyme. Mechanism of action of enzymes: active site, activation energy, transition state complex.
Multienzyme complex: pyruvate dehydrogenase; Isozyme: lactate dehydrogenase

Microbial growth in response to environment (4%)
- temperature (psychrophiles, psychrotrophs, mesophiles, thermophiles, thermodurics), pH (acidophiles, alkaliphiles), solute and water activity (halophiles, xerophiles, osmophiles), oxygen (aerobes, anaerobes, microaerophilic, facultative aerobes, facultative anaerobes), hydrostatic pressure (barophiles). Microbial growth in response to nutrition and energy – autotroph/phototroph, heterotroph; photoorganoheterotroph, chemolithotroph: chemolithoautotroph, chemolithoheterotroph, chemoheterotroph, photolithoautotroph.

Human Physiology (7%)
Digestion and absorption: Alimentary canal and digestive glands; Role of digestive enzymes and gastrointestinal hormones; Peristalsis, digestion, absorption and assimilation of proteins, carbohydrates and fats.

Breathing and Respiration: Respiratory organs in animals (recall only); Respiratory system in humans; Mechanism of breathing and its regulation in humans– Exchange of gases, transport of gases and regulation of respiration, Respiratory volumes; Disorders related to respiration-Asthma, Emphysema, Occupational respiratory disorders.

Excretory products and their elimination: Modes of excretion – Ammonotelism, ureotelism, uricotelism; Human excretory system–structure and function; Urine formation, osmoregulation; Regulation of kidney function– Renin-angiotensin, Atrial Natriuretic Factor, ADH and Diabetes insipidus; Role of other organs in excretion; Disorders-Uraemia, Renal failure, Renal calculi, Nephritis; Dialysis and artificial kidney.

Locomotion and Movement: Types of movement – ciliary, flagellar, muscular; Skeletal system; Joints; Disorders of muscular and skeletal system- Myasthenia gravis,Tetany, Muscular dystrophy, Arthritis, Osteoporosis, Gout.

Chemical coordination and regulation: Endocrine glands and hormones; Human endocrine system-Hypothalamus, Pituitary, Pineal, Thyroid, Parathyroid, Adrenal, Pancreas, Gonads; Mechanism of hormone action ; Role of hormones as messengers and regulators, Hypo-and hyperactivity and related disorders (Common disorders e.g. Dwarfism, Acromegaly, Cretinism, goiter, exopthalmic goiter, diabetes, Addison's disease).

Important topics in biochemistry : Food Biochemistry and Microbial interactions (4%)

Preservation techniques: Physical methods - high temperature, low temperature, irradiation, aseptic packaging. Pasteurization of milk: LTH, HTST, UHT and efficacy of pasteurization - Phosphatase test, Chemical methods - salt, sugar, benzoates, citric acid, ethylene oxide, nitrate and nitrite. Spoilage organisms: *Salmonella, Clostridium*, Coliforms,

Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation. Microbe-Plant interaction: Symbiotic and non-symbiotic interactions. Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria.

Molecular biology (7%)

DNA: Watson – Crick model of DNA; Prokaryotic DNA (Circular DNA, Supercoiled, Palindromic), Plasmids; Eukaryotic DNA (Repetitive sequences, split genes, nucleosomes), mitochondrial and chloroplast DNA; Guanine quadruplex (G4) DNA.

RNA: mRNA, rRNA, tRNA, non-coding RNA, micro-RNA and Si RNA

Modes of replication - Conservative, semi conservative (Meselson - Stahl experiment) and dispersive; Processes and enzymes involved in replication;

Transcription: Prokaryotes and eukaryotes, Differences between prokaryotic and eukaryotic transcription process.

Translation**:** Concept of genetic code, Properties; Ribosomes as sites of protein biosynthesis; amino acid activation and specificity;

Translation of proteins and post modification, Differences between prokaryotic and eukaryotic translation process.

Basics of Inorganic Chemistry: Chemical bonding, Molecular Structure, Coordination compounds and classification of Elements (5%)

Concept of elements, atoms and molecules, atomic and molecular masses, mole concept and molar mass; percentage composition and empirical and molecular formula; chemical reactions, stoichiometry and calculations based on stoichiometry. Introduction to valence electrons, ionic bond, covalent bond, bond parameters, Lewis structure, polar character of covalent bond, covalent character of ionic bond.

Significance of classification, brief history of the development of periodic table, modern periodic law and the present form of periodic table, periodic trends in properties of elements – atomic radii, ionic radii, inert gas radii, ionization enthalpy, electron gain enthalpy, electronegativity, valence

Classification of solids based on different binding forces :molecular, ionic covalent and metallic solids, amorphous and crystalline solids(elementary idea),unit cell

Introduction, ligands, coordination number, importance of coordination compounds (in qualitative analysis, extraction of metals and biological systems)

Basics of Physical chemistry: Surface Chemistry, Electrochemistry and Chemical Kinetics (5%)

Adsorption – physisorption and chemisorption; factors affecting adsorption of gases on solids; catalysis :homogenous and heterogeneous

Redox reactions; conductance in electrolytic solutions, specific and molar conductivity variations of conductivity with concentration,

Rate of a reaction (average and instantaneous), factors affecting rates of reaction: concentration, temperature, catalyst; order and molecularity of a reaction

Basics of Analytical Chemistry: Solutions, pH metry, Data collection and Presentation (5%)

Types of solutions, expression of concentration of solutions of solids in liquids

pH of solutions, solution of known and varied concentrations of acids, bases and salts using pH paper or universal indicator; Comparison of the pH of solutions of strong and weak acids of same concentration.

Introduction to Statistics: Collection of data, presentation of data — tabular form, ungrouped / grouped, bar graphs. Importance of statistical analysis in biological data management. Sampling schemes – Simple Random sampling, systemic sampling, Stratified sampling, Cluster sampling

Spectroscopic Techniques and Introduction to biophysical chemistry (7%)

Electromagnetic radiation, interaction of radiation with matter, principle of UV-visible absorption spectrophotometry, Lambert's Law, Beer's Law, working of a spectrophotometer. Applications of UV-visible absorption spectrophotometry. Introduction to fluorescence spectrophotometry. Introduction, principle and applications of IR, NMR and mass spectroscopy;.

Introduction to biophysical chemistry: protein structure, protein folding and spectroscopic tools to study them

Chromatography: (**4%)**

Introduction to chromatographic techniques: Principle, instrumentation and applications of Paper Chromatography, Thin Layer Chromatography and Ion Exchange Chromatography.

Basic Organic Chemistry and Stereochemistry (7%)

General introduction, classification and IUPAC nomenclature of organic compounds. Common functional groups: Alkanes, alkenes, alkynes, alcohols, amines, halogenated hydrocarbons, carbonyl compounds, etc

Concept of isomerism; types of isomerism; stereoisomerism, conformational isomerism; conformations with respect to ethane, butane and cyclohexane; interconversion of wedge

formula, Newmann, Sawhorse and Fischer representations; concept of chirality (up to two carbon atoms); configuration: geometrical and optical isomerism; enantiomerism, diastereomerism and meso compounds); threo and erythro; D and L; cis – trans nomenclature; CIP Rules: R/ S (for up to 2 chiral carbon atoms) and E/Z Nomenclature (for up to two C=C systems).

Polymers**:** Classification – Natural and synthetic, Biodegradable and non-biodegradable polymers.

Fundamentals of Organic Reactions: (4%)

Curved arrow notation, drawing electron movement with arrows, half and double headed arrows, in organic reaction mechanisms; physical effects, electronic displacements: inductive effect, electromeric effect, resonance and hyperconjugation. Cleavage of bonds: homolysis and heterolysis. Introduction to reactive intermediates: carbocations, carbanions, carbenes, nitrenes, free radicals. Concepts of electrophile, nucleophile, substitution, addition, elimination, rearrangement reactions.

Environmental Chemistry and Chemistry in Everyday Life (3%)

Environmental pollution – Air, water and soil pollution, chemical reactions in atmosphere, smogs, major atmospheric pollutants; acid rain, ozone and its reactions, effects of depletion of ozone layer, greenhouse effect and global warming – pollution due to industrial wastes; green chemistry as an alternative tool for reducing pollution, strategy for control of environmental pollution

1. Chemicals in medicines – analgesics, tranquilizers, antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamines. 2. Chemicals in food – preservatives, artificial sweetening agents, elementary idea of antioxidants. 3. Cleansing agents – soaps and detergents, cleansing action.

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