Syllabus for Physiology Major and Minor

Semester-I

Total credit – 05 (Theory + Practical) Total marks: 100 (50+50)

Theory

Course Name: CELL BIOLOGY AND BIOCHEMISTRY Course Code: BSCPHYMJ101 Marks: 50 (15+35)

Unit - I: Brief Overview of Physiological Systems [5 Marks]

Brief Overview of Physiological Systems: Basics of anatomy, functional organization and physiological functions of Cardiovascular system, Respiratory system, Digestive system, Endocrine system, Nervous system, Reproductive system, Excretory system and Blood and Immune system.

Unit – II: Cellular Basis of Physiology [15 Marks]

General concept of structure and functions of animal tissues and cells: Anatomy, electron microscopic structure and functions of animal tissues, eukaryotic cells and cell organelles (Nucleus, endoplasmic reticulum, ribosomes, Golgi bodies, mitochondria) lysosomes, peroxisomes, cytoskeletal elements, centrosomes and plasma membrane.

Cellular transport: Passive and active transport. Ion channels, ionophores. Intercellular communication: Basic idea of tight junctions, gap junctions, adherens junctions, desmosomes and cell adhesion molecules, Extracellular matrix components.

Unit – III: Chemistry of Biomolecules [30 Marks]

Carbohydrates: Definition and classification. Monosaccharides – Classification, structure, stereoisomerism, optical isomerism, optical activity, epimerism. Cyclic structures- Pyranose and furanose forms, anomerism, mutarotation and its mechanism. Chemical reactions of monosaccharides (Glucose & Fructose) -Reactions with concentrated mineral acids, alkali, phenylhydrazine and their biochemical importance. Derivatives of monosaccharides -Amino sugars, deoxy sugars, sugar alcohols, sugar acids, sugar esters, their biochemical and physiological importance. Disaccharides – Maltose, Lactose and Sucrose: Structure, Occurrence and Physiological importance. Polysaccharides – Starch, Glycogen, dextrin,Cellulose, Glycosaminoglycans, Glycoproteins, Sialic acids.

Lipids: Definition and classification. Fatty acids - Classification, systemic nomenclature and structure. Mono-, Di- and Triglycerides. Properties of Fat and Fatty acids Hydrolysis,

saponification number, Iodine number, Acetyl number, Acid number, Reichert-Meissl number. Cis-trans isomerism. Eicosanoids, Phospholipids, Glycolipids, Sphingolipids, Steroids and sterols, Cholesterol & its ester -their structure and physiological importance. Lipoproteins - Structure and classification. Micelle, bilayer, Liposome.

Amino acids: Classification, Structure, Nomenclature and Optical properties. Protonic equilibria of amino acids – Zwitterions, Isoelectric point, titration curve of amino acids. Reactions with ninhydrin and formaldehyde.

Peptides and Proteins: Structure and properties of peptide bonds – Phi and Psi angles. Reactions with Sanger's and Edman's reagent. Biuret reaction. Different levels of protein structure: Primary, Secondary (α -helix and β -pleated sheet), Tertiary and Quarternary. Forces stabilizing the structures. Denaturation and Renaturation. Purine and Pyrimidine bases: Structure, nomenclature and tautomerism. Nucleic acids:Nucleosides and Nucleotides-structure. Polynucleotides.DNA double helix, Primary, Secondary and Tertiary structure.A-DNA, B-DNA and Z-DNA. RNA - Structure, types, features. Denaturation and annealing of DNA.Hyperchromicity, melting temperature and half Cot value.

Practical

Marks: 30 [Experiment:20, *Viva-Voce*:05, Laboratory Note Book:05] Paper Name: Fresh Tissue and Biochemistry

1. Study of Models / Charts of different body organ systems & organs – Anatomical position, Structure & Functions.

2. Examination and staining of fresh tissues: Squamous, Ciliated and Columnar Epithelium by Methylene Blue stain.

3. Qualitative tests for the identification of physiologically important substances:

Hydrochloric acid, Lactic Acid, Uric Acid, Albumin, Gelatin, Peptone, Starch, Dextrin,

Glucose, Fructose, Lactose, Sucrose, Urea, Acetone, Glycerol and Bile salts.

Semester-II

Total credit – 05 (Theory + Practical) Total marks: 100 (50+50)

Theory

Course Name: CELL SIGNALLING, ENZYMES AND BIOPHYSICS Course Code: BSCPHYMJ201 Marks: 50 (15+35)

Unit – I: Cell signaling [10 Marks]

Cell signaling: Definition, Types (Autocrine, Endocrine, Paracrine and signaling by direct contact), Stages of cell signaling (Reception, Transduction and Response), Cell surface receptor proteins – ion channel coupled, G-protein coupled and enzyme-coupled. Intracellular messengers – cAMP, cGMP, IP3, DAG, Protein kinases, Ca2+,CO, NO. Signal transduction pathways: Phosphatidyl inositides, MAP kinase, JAK-STAT, Raf-Ras, SMAD.

Unit – II: Enzyme – I [20 Marks]

Definition, Chemical nature of enzymes, comparison between enzymes and inorganic catalyst, Classification, EC. Nomenclature, Concept of apoenzyme, holoenzyme, coenzyme, cofactors and prosthetic group.Metals in enzyme activity, Enzyme - Substrate complex, Active site, Binding site, Models for Enzyme – Substrate interactions (Fischer's template of Lock and Key model and Koshland's induced fit model), Enzyme specificity, Concept of initial rate, maximum velocity and steady-state kinetics. Michaelis-Menten constant (Km), Derivation of Michaelis-Menten equation, Graphical representation of hyperbolic kinetics, Linear transformation of Michaelis-Menten equation: Lineweaver-Burk double reciprocal plot, *Eadie- Hofstee plot, Wolf-Hanes plot*, Significance of Km and Vmax.

Factors influencing enzyme-catalyzed reactions: substrate concentration, enzyme concentration, pH, temperature. Competitive, noncompetitive and uncompetitive inhibitions. Regulation of enzyme activities — Irreversible covalent activation, Reversible covalent modifications, Allosteric modulation, Sigmoid Kinetics and Hill equation, K and M series of enzymes. Feedback inhibition. Rate-limiting enzymes and its features, multi-enzymes, Isozymes, Ribozymes and Abzymes.

Unit – III : Biophysics and Biophysical Principle [20 Marks]

Diffusion: Its characteristics, factors influencing and physiological applications.

Osmosis: Osmotic pressure – laws, determination – freezing point depression method and physiological applications.

Surface tension & viscosity: Physiological applications. pH & Buffer, Henderson Hasselbach – equation (quantitative problems).Determination of pH.

Colloids: Classification, properties (optical, electrical, electrokinetic), Physiological importance of colloids. Definition and physiological importance of Dialysis, adsorption, Gibbs-Donnan membrane equilibrium, endocytosis.

Thermodynamics: Type of surroundings and systems. First Law– Internal energy, enthalpy. Second Law – Entropy, Free energy change, Endergonic and Exergonic reactions, Reversible and Irreversible processes, Equilibrium constant. Physiological steady-state, Living body as a thermodynamic system.

Practical

Marks: 30 [Experiment:20, *Viva-Voce*:05, Laboratory Note Book:05] Paper Name: Fresh Tissue and Biochemistry

- Study and identification of stained section of different mammalian tissues and organs: Parotid gland, Submaxillary gland, Sublingual gland, Tongue, Oesophagus, Stomach, Duodenum, Jejunum, Ileum, Large intestine, Liver, Kidney, Ureter, Pancreas, Spleen, Lymph gland, Lung, Trachea, Thyroid gland, Adrenal gland, Ureter, Kidney, Skin, Ovary, Testis, Uterus, Spinal Cord, Cerebellum, Cerebrum, Cardiac muscle, Skeletal Muscle, Smooth muscle, Artery, Vein, Bone, Cartilage.
- 2. Permanent Slide Preparation and Staining
- 3. Study of charts on Cell signalling
- 4. Demonstration: Preparation of Buffer and pH measurement.

MULTIDISCIPLINARY COURSES (MD)

SEMESTER - I Total Credit: 3 Full Marks: 50 (35 +15)

Theory

Course Name: Biochemistry and Digestion Course Code: BSCPHYMD101

Unit-I: Cellular Basis of Physiology [10 Marks]

Structure, Types, location and functions of animal tissues. Structure and functions of plasma membrane, nucleus and different cell organelles – Endoplasmic reticulum, Golgi bodies, Mitochondria, Lysosome and Peroxisome.

Unit-II: Biophysical Principles[10 Marks]

Physiological importance of the following physical processes: Diffusion, Osmosis and Surface tension. pH and Buffers – Significance in human body and maintenance of pH in the blood. Colloids - Classification and physiological importance.

Unit-III: Enzymes [10 Marks]

Classification, factors affecting enzyme action. Concept of coenzymes, prosthetic groups, mettaloenzymes, isozymes, Abzymes, Ribozymes, Multienzymes, Allosteric enzymes,

Unit-IV: Biomolecules [10 Marks]

Carbohydrates: Definition and classification. Monosaccharides – Classification, structure, physiological importance. Disaccharides – Maltose, Lactose and Sucrose: Structure, occurrence and physiological importance. Polysaccharides – Starch, Glycogen, Dextrin, Cellulose.

Lipids: Definition and classification. Fatty acids: Classification. Definition and importance of Saponification number, Iodine Number, Acetyl Number, Acid number, Reichart-Meissel number, Polenske number. Phospholipids, Cholesterol & its ester -- physiological importance.

Amino acids, Peptides and Proteins: Classification and structure. Structure of peptide bonds. Nucleic acids: Structure of DNA and RNA.

Unit-V: Digestion & Metabolism [10 Marks]

Digestion: Structure in relation to functions of alimentary canal and digestive glands.

Composition, functions and regulation of secretion of digestive juices including bile. Digestion and absorption of carbohydrate, protein and lipid. Movements of the stomach and small intestine.

Metabolism: Glycolysis, TCA cycle, Importance of Glycogenesis, Glycogenolysis and.

Gluconeogenesis. Beta oxidation of saturated fatty acid. Importance of Ketone bodies.

Deamination & Transamination. Formation of urea and its regulation.

SEMESTER - II Total Credit: 3 Full Marks: 50 (35 +15)

Theory Course Name: Cardio-respiratory and Nervous System Course Code: BSCPHYMD201

Unit-I: Blood and Body Fluids [10 Marks]

Composition and functions of Plasma proteins: origin and functions. Blood cells-- their morphology and functions. Heamatopoiesis. Hemoglobin: different types of compounds and derivatives. Coagulation of blood. Lymph and tissue fluids: composition, formation, and functions.

Unit-II: Cardiovascular System [10 Marks]

Anatomy and histology of the heart. Properties of cardiac muscle. Origin and propagation of cardiac impulse. Cardiac cycle, Heart sounds, Heart rate, Cardiac output. Blood pressure and factors controlling it. Baro- and chemoreceptors. Vasomotor reflexes.

Unit-III: Respiratory System [10 Marks]

Anatomy and histology of the respiratory passage and organs. Role of respiratory muscles in breathing. Lung volumes and capacities. Exchange of respiratory gases between lung and blood and between blood and tissues. Transport of oxygen and carbon dioxide in blood. Regulation of respiration - neural and chemical.

Unit-IV: Nerve-muscle Physiology [10 Marks]

Structure of neurons. Origin and propagation of nerve impulse. Properties of nerve fibers: all or none law, rheobase and chronaxie, refractory period. indefatiguability. Synapses: structure, mechanism of synaptic transmission. Motor unit. Myoneural junction. Degeneration and

regeneration in nerve fibers. Different types of muscle and their structure. Excitation contraction coupling. Isotonic and isometric contractions. Properties of muscle: all or none law, beneficial effect, summation, refractory period, tetanus, fatigue.

Unit-V: Renal Physiology [10 Marks]

Structure and function relationship of kidney. Mechanism of formation of urine. Normal and abnormal constituents of urine. Physiology of micturition. Renal regulation of acid-base balance. Non-excretory functions of kidney.

SKILL ENHANCEMENT COURSES (SEC)

SEMESTER - I Total Credit: 3 Full Marks: 50 (30 +20)

Practical Course Name: Biochemistry and Human Experiment Course Code: BSCPHYSE101

Unit I: Preparation of solution, calculation of molecular weight & equivalent weight, preparation of molar solutions, normal solutions, percent solutions & reagents, dilution techniques. Preparation of N/10 NaOH, N/10 Oxalic Acid, N/10 HCl, N/10 H2SO4 solution, N/100 KMnO4 Solution, N/100 Sodium Oxalate Solution. Standardization of approx N/10 NaOH, N/10 HCl, N/10 H2SO4 solution against standard N/10 Oxalic acid solution. Standardization of approx N/100 KMnO4 Solution.

Unit II: Determination of BMI, BSA, PI, CI, waist hip ratio, MUAC, body fat percentage. Determination of physical fitness by Harvard and modified Harvard Step Tests Measurement of systolic and diastolic arterial blood pressure by sphygmomanometer and determination of pulse and mean pressure. Determination of heart rate by palpation.

SEMESTER - II Total Credit: 3 Full Marks: 50 (35 +15)

Theory Course Name: Clinical Biochemistry and Histochemistry Course Code: BSCPHYSE201

Course: Practical, Paper Code: PHY-SEC21-PR-P04 [Credit: 02; Marks: 50] Unit I:

1. Estimations of Cholesterol, Triglyceride, HDL, LDL, SGPT and SGOT by standard biochemical kit.

2. Estimations of urea, Creatinine, Uric acid by standard biochemical kit. **Unit II:**

Haematoxylin and eosin staining of paraffin tissue sections (Liver, Kidney, Ovary, Testis, Pancreas, Lung).