



# UNIVERSITY OF CALCUTTA

## Notification No. CSR/13/2023

It is notified for information of all concerned that in terms of the provisions of Section 54 of the Calcutta University Act, 1979, (as amended), and, in exercise of his powers under 9(6) of the said Act, the Vice-Chancellor has, by an order dated 11.07.2023 approved the Syllabi of the under mentioned subjects for semester wise Four-year (Honours & Honours with Research) / Three-year (Multidisciplinary) programme of U.G. courses of studies, as applicable under CCF, 2022 . under this University, as laid down in the accompanying pamphlet.


### **Name of Subject:**

1. Anthropology
2. BBA
3. Bengali
4. BFAD
5. Bio Chemistry
6. Botany
7. Chemistry
8. Commerce
9. Economics
10. Education
11. English
12. Geology
13. Hindi
14. History, Islamic History & Culture
15. Home Science
16. Human Rights
17. Journalism & Mass Communication
18. Mathematics
19. Microbiology (Honours)
20. Molecular Biology
21. Philosophy
- ✓ 22. Physiology
23. Political Science
24. Psychology
25. Social Science
26. Sociology
27. Urdu
28. Women's Studies
29. Zoology

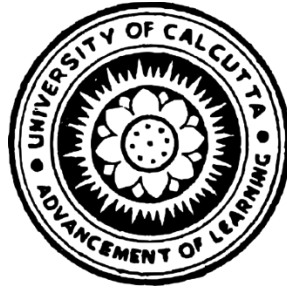
The above shall be effective from the academic session 2023-2024.

SENATE HOUSE

KOLKATA-700 073

  
12/7/2023  
Prof. (Dr.) Debasis Das

Registrar



# UNIVERSITY OF CALCUTTA

**First Year Two Semesters (1<sup>st</sup> & 2<sup>nd</sup> Semester)  
Syllabi of Four Years B.Sc. (Honours & Honours  
with Research) Courses in Studies (Under  
Curriculum and Credit Framework, 2022)  
In  
Physiology**

**2023**

**Course and Curriculum**  
**w. e. f. 2023-2024**  
**Subject: PHYSIOLOGY (PHY)**  
**Level: Under Graduate**

**Name of the Programme: 4 Years B.Sc. B.Sc. (Honours & Honours with Research) Courses in Studies (Under Curriculum and Credit Framework, 2022) in Physiology**

**Programme Specific Objectives:**

The primary objective of the course is to know the 'Human Body' as the most resourceful creation of the nature. It basically focuses on the structural and functional inter-relationship of different systems, their molecular integration, actions and reactions under different internal and external factors and conditions, the remedies including the modern concepts and technologies to combat any biomedical threat on man and mankind.

**Outcome of the programme:**

- Units of a Physiological system and its molecules, Indian contributions. Intercommunications within human system, Basic internal Modulators and Parametric control system.
- Fluid tissues, Fluid Connectivity, Effects of fluid pumping system, and Basic operating systems of life and their functioning
- Supply and Requirements of Essentials from outside and their effects.
- Technology for recording, screening and estimating the different aspects of the Physiological system and allied.
- Human genome and all molecular basics along with specific biomolecular contributions required for physiological system development.
- Pathogens and environments as affecting human health and its manifestations: their trends and interference in deadly diseases and possible remedial measures.
- The ergonomic aspects and issues related to human and its system.
- Yoga for holistic up keeping of both neuronal and physical health. Sports and exercise physiological aspects for future development of physical ability with in depth scientific inputs inclusive for society.
- Advanced technologies, Instruments and methodologies for identification, stage differentiation, determination of different chronic, acute and critical diseases.

- A vision towards the modern approach of the subject for advancement of research and future orientation for the long term benefit of the society.

## Basic Structural Framework of the Syllabus

### CORE COURSES (CC), THEORY (TH), PRACTICAL (PR), INTERDISCIPLINARY COURSES (IDC), SKILL ENHANCEMENT COURSES (SEC)

#### CORE COURSES (CC):

Course Code	Subject of the Course	Distribution of Credit		Total Credit	Marks
		TH	PR		
<b>Semester - I</b>					
PHY-CC11-TH-P01	<b>Theory</b> (History of Physiology and medicine and contribution of Indian Scientists in the field of Physiology and allied health sciences, Brief overview of Physiological Systems, Cellular Basis of Physiology, Cellular transport, Chemistry of Biomolecules).	03	00	03	75
PHY-CC11-PR-P02	<b>Practical</b> (History of Physiology and medicine and contribution of Indian Scientists in the field of Physiology and allied health sciences, Brief overview of Physiological Systems, Cellular Basis of Physiology, Cellular transport, Chemistry of Biomolecules)	00	01	01	25
<b>Total</b>		<b>03</b>	<b>01</b>	<b>04</b>	<b>100</b>
<b>Semester - II</b>					
PHY-CC21-TH-P03	<b>Theory</b> (Cell signaling, Enzymes, Biophysiochemical principles).	03	00	03	75
PHY-CC21-PR-P04	<b>Practical</b> (Cell signaling, Enzymes, Biophysiochemical principles).	00	01	01	25
<b>Total</b>		<b>03</b>	<b>01</b>	<b>04</b>	<b>100</b>

#### Interdisciplinary Courses (IDC)

Course Code	Subject of the Course	Distribution of Credit		Total Credit	Marks
		TH	PR		

<b>Semester - I</b>					
<b>HPY-IDC11-TH-P01</b>	<b>Theory</b> (Cellular Basis of Physiology, Biophysical Principles, Enzymes, Bio-molecules, Digestion & Metabolism).	<b>02</b>	<b>00</b>	<b>02</b>	<b>50</b>
<b>HPY-IDC11-PR-P02</b>	<b>Practical</b> (Cellular Basis of Physiology, Biophysical Principles, Enzymes, Bio-molecules, Digestion & Metabolism).	<b>00</b>	<b>01</b>	<b>01</b>	<b>25</b>
<b>Total</b>		<b>02</b>	<b>01</b>	<b>03</b>	<b>75</b>
<b>Semester - II</b>					
<b>HPY-IDC21-TH-P03</b>	<b>Theory</b> (Blood and Body Fluids, Cardiovascular System, Respiratory System, Nerve-muscle Physiology, Renal Physiology).	<b>02</b>	<b>00</b>	<b>02</b>	<b>50</b>
<b>HPY-IDC21-PR-P04</b>	<b>Practical</b> (Blood and Body Fluids, Cardiovascular System, Respiratory System, Nerve-muscle Physiology, Renal Physiology)	<b>00</b>	<b>01</b>	<b>01</b>	<b>25</b>
<b>Total</b>		<b>02</b>	<b>01</b>	<b>03</b>	<b>75</b>
<b>Skill Enhancement Courses (SEC)</b>					
<b>Course Code</b>	<b>Subject of the Course</b>	<b>Distribution of Credit</b>		<b>Total Credit</b>	<b>Marks</b>
		<b>TH</b>	<b>PR</b>		
<b>Semester - I</b>					
<b>PHY-SEC11-TH-P01</b>	<b>Theory</b> (Clinical Importance of Biomolecules, Protein Disorders, Age Related Health Issues, Work and Exercise Physiology).	<b>02</b>	<b>00</b>	<b>02</b>	<b>50</b>
<b>PHY-SEC11-PR-P02</b>	<b>Practical</b> (Clinical Importance of Biomolecules, Protein Disorders, Age Related Health Issues, Work and Exercise Physiology).	<b>00</b>	<b>02</b>	<b>02</b>	<b>50</b>
<b>Total</b>		<b>02</b>	<b>02</b>	<b>04</b>	<b>100</b>
<b>Semester - II</b>					
<b>PHY-SEC21-TH-P03</b>	<b>Theory</b> (Clinical Biochemistry, Laboratory Automation, Management and Safety; Histological Techniques for Pathological Identification).	<b>02</b>	<b>00</b>	<b>02</b>	<b>50</b>
<b>PHY-SEC21-PR-P04</b>	<b>Practical</b> (Clinical Biochemistry, Laboratory Automation, Management and Safety;	<b>00</b>	<b>02</b>	<b>02</b>	<b>50</b>

	Histological Techniques for Pathological Identification).				
	<b>Total</b>	<b>02</b>	<b>02</b>	<b>04</b>	<b>100</b>

## **CORE COURSES (CC)**

### **Semester - I**

**Total credit – 04 (Theory - 03, Practical - 01); Total marks: 100**

**Course – I: Theory, Paper Code: PHY-CC11-TH-P01 [Credit: 03; Marks: 75]**

**[History of Physiology and medicine and contribution of Indian Scientists in the field of Physiology and allied health sciences, Cellular Basis of Physiology, Cellular transport, Chemistry of Biomolecules]**

**Unit - I: History of Physiology and medicine and contribution of Indian Scientists in the field of Physiology and allied health sciences and Brief Overview of Physiological Systems [15 Marks]**

History of Physiology and medicine and contribution of Indian Scientists in the field of Physiology and allied health sciences:

Subodh Chandra Mahalanobis, Sacchidananda Banerjee, Dilip Mahalanabis, Autar Singh Paintal, John Burdon Sanderson Haldane, Upendra Nath Brahmachari.

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 - I [15 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.

#### **Unit – IV: Chemistry of Biomolecules - II [15 Marks]**

Lipids: Definition and classification. Fatty acids - Classification, systematic 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.

#### **Unit – V: Chemistry of Biomolecules - III [15 Marks]**

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 ( $\alpha$ -helix and  $\beta$ -pleated sheet), Tertiary and Quaternary. 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.

#### **DISTRIBUTION OF QUESTIONS IN THEORETICAL PAPER**

1. From each unit, one question of **15 marks** each with one alternative are to be set. The **15 marks** questions may be subdivided.
2. Candidates have to **attempt all the five** questions.

#### **Course – II: Practical, Paper Code: PHY-CC11-PR- P02 [Credit: 01; Marks: 25]**

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.

#### **DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER**

**[Experiment:15, Viva-Voce:05, Laboratory Note Book:05]**



## Semester-II

**Total credit – 04 (Theory-03, Practical-01) Total marks: 100**

**Course – III: Theory, Paper Code: PHY-CC21-TH-P03 [Credit: 03; Marks: 75]  
[Cell signaling, Enzymes, Biophysicochemical principles]**

### **Unit – I: Cell signaling [15 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, IP<sub>3</sub>, DAG, Protein kinases, Ca<sup>2+</sup>, CO, NO. Signal transduction pathways: Phosphatidylinositides, MAP kinase, JAK-STAT, Raf-Ras, SMAD.

### **Unit – II: Enzyme – I [15 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 (K<sub>m</sub>), 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 K<sub>m</sub> and V<sub>max</sub>.

### **Unit – III: Enzyme – II [15 Marks]**

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 – IV: Biophysics and Biophysical Principles - I [15 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.

### **Unit – V: Biophysics and Biophysical Principles – II [15 Marks]**

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.

**DISTRIBUTION OF QUESTIONS IN THEORETICAL PAPER**

1. From each unit, one question of **15 marks** each with one alternative are to be set. The **15marks** questions may be subdivided.
2. Candidates have to **attempt all the five** questions.

**Course – IV: Practical, Paper Code: PHY-CC21-PR- P04 [Credit: 01; Marks: 25]**

1. 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. Study of charts on Cell signaling

**Demonstration:** Preparation of Buffer and pH measurement.

**DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER**

**[Experiment: 15, Viva-Voce: 05, Laboratory Note Book:05]**

## INTERDISCIPLINARY COURSES (IDC)

### SEMESTER - I

**Total Credit: 3 [Theory: 2, Practical: 1], Full Marks:75**

**Course: Theory, Paper Code: PHY- IDC11-TH-P01 [Credit: 02; Marks: 50]**  
**[Cellular Basis of Physiology, Biophysical Principles, Enzymes, Bio-molecules, Digestion & Metabolism]**

**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, metalloenzymes, 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.

**DISTRIBUTION OF QUESTIONS IN THEORETICAL PAPER**

1. From each unit, one question of **10 marks** each with one alternative are to be set. The **10 marks** questions may be subdivided.

2. Candidates have to **attempt all the five** questions.

**Course: Practical, Paper Code: PHY- IDC11-PR-P02 [Credit: 01; Marks: 25]**

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

**2.Qualitative tests for identification of :** Glucose, Fructose, Lactose, Sucrose, Starch, Dextrin, Lactic acid, Hydrochloric acid , urea, Albumin, peptone, Acetone, Glycerol and Bile Salts.

**3.Quantitative estimation** of ammonia and amino nitrogen by Sorensen's formol titration method (percentage and total to be done)

**DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER**

**[Experiment: 15, Viva-Voce: 05, Laboratory Note Book:05]**

## **SEMESTER - II**

**Total Credit: 3 [Theory: 2, Practical: 1], Full Marks:75**

**Course: Theory, Paper Code: PHY- IDC21-TH-P03 [Credit: 02; Marks: 50]**

**[Blood and Body Fluids, Cardiovascular System, Respiratory System, Nerve-muscle Physiology, Renal Physiology]**

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

Composition and functions of Plasma proteins: origin and functions. Blood cells-- their morphology and functions. Erythropoiesis. 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. indefatigability. 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.

**DISTRIBUTION OF QUESTIONS IN THEORETICAL PAPER**

1. From each unit, one question of **10 marks** each with one alternative are to be set. The **10 marks** questions may be subdivided.
2. Candidates have to **attempt all the five** questions.

**Course: Practical, Paper Code: PHY- IDC21-PR-P04 [Credit: 01; Marks: 25]**

1. Preparation and staining of human blood film with Leishman's stain and identification of different types of blood cells.
2. Determination of haemoglobin by Shali's haemoglobinometer , bleeding time and Clotting time determination.
3. Measurement of systolic and diastolic pressure by sphygmomanometer and determination of pulse pressure and mean pressure by auscultatory method.
4. Pneumographic recording of normal respiratory movements and effects of hyperventilation and breath-holding.

**DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER**

**[Experiment: 15, Viva-Voce: 05 , Laboratory Note Book:05]**

## **SKILL ENHANCEMENT COURSES (SEC)**

### **Semester – I**

#### **SEC-1**

**Total Credit: 4 [Theory: 2, Practical:2], Marks: 100**

**Course: Theory, Paper Code: PHY-SEC11-TH-P01 [Credit: 02; Marks: 50]  
[Clinical Importance of Biomolecules, Protein Disorders, Age Related Health Issues, Work and Exercise Physiology]**

#### **Unit – I: Clinical Importance of Biomolecules [10 Marks]**

Carbohydrates: Estimation of glucose, glycosurias, OGTT, hyper & hypoglycemia, blood glucose regulation and role of hormones; diabetic coma, Lipids- lipid profile estimation, hypercholesterolemia, hyperlipoproteinemia, atherosclerosis and its risk factors. Proteins—albumin, hypoalbuminemia, hypoproteinemia, Bence Jones proteins, proteins in CSF and their significance.

#### **Unit – II: Protein Disorders [10 Marks]**

Clinical features and laboratory findings in disorders of the plasma proteins, acute phase proteins, serum proteins and albumin, serum and urine protein electrophoresis, hypo and hyperalbuminemia; hypo- and hyperglobulinemias, Alpha-1-antitrypsin deficiency, Homozygotes vs. heterozygotes e.g. phenylketonuria, tyrosinemia, cystic fibrosis and sweat tests, amino-acidurias, organic acidurias. Protein folding disorders (Alzheimers, prions and amyloid). Collagen disorders.

#### **Unit – III: Age Related Health Issues [10 Marks]**

Special problems in pediatrics (Respiratory distress syndrome; neonatal hyperbilirubinemia; cystic fibrosis; Down syndrome). Neonatal health management; Vaccination in Newborn babies, Recommended immunization schedule. Adult health problems (Non alcoholic fatty liver, Atherosclerosis, Obesity, Smoking), Geriatric health problems (Alzheimer disease, Parkinson disease, Osteoarthritis, COPD, Depression and Dementia, Hearing loss, Cataracts and refractive errors).

#### **Unit IV: Work and Exercise Physiology-I [10 Marks]**

Introduction: Definitions of work and exercise Physiology, Fundamental concepts of work—different categories of work. Physical work—its definition and nature—isotonic, isometric and isokinetic, positive and negative work.

Physiological basis of work: Concept of physiological work. Power and capacity relation. Workload – light, moderate (submaximal) and heavy (maximal) depending on intensity and duration of work. Changes in heart rate, oxygen consumption and blood pressure to assess person's ability to withstand work load. Effect of heat stress on physiological responses to work load,

**Unit V: Work and Exercise Physiology-II [10 Marks]**

Energetics: Work power and energy, sources of energy and energy demand for different activities. Aerobic and anaerobic capacity, EPOC, lactate threshold and lactate tolerance and their usefulness. Determination of energy cost at rest, work and fatigue by direct and indirect methods. Athletic performance based on aerobic and anaerobic capacity. Brief general idea about nutritional aspects of sports.

**DISTRIBUTION OF QUESTIONS IN THEORETICAL PAPER**

1. From each unit, one question of **10 marks** each with one alternative are to be set. The **10 marks** questions may be subdivided.
2. Candidates have to **attempt all the five** questions.

**Course: Practical, Paper Code: PHY-SEC11-PR-P02 [Credit: 02; Marks: 50]**

**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 H<sub>2</sub>SO<sub>4</sub> solution, N/100 KMnO<sub>4</sub> Solution, N/100 Sodium Oxalate Solution. Standardization of approx N/10 NaOH, N/10 HCl, N/10 H<sub>2</sub>SO<sub>4</sub> solution against standard N/10 Oxalic acid solution. Standardization of approx N/100 KMnO<sub>4</sub> Solution against Standard Sodium Oxalate Solution.

**Unit II:** Determination of BMI, BSA, PI, waist hip ratio, 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.

**DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER**

[Experiment: 30 (15 marks from each unit), Viva-Voce: 10, Laboratory Note Book: 10]

## Semester – I

### SEC-2

**Total Credit: 4 [Theory: 2, Practical: 02], Marks: 100**

**Course: Theory, Paper Code: PHY-SEC21-P03 [Credit: 02; 50 Marks]**

**[Clinical Biochemistry, Laboratory Automation, Management and Safety  
Histological Techniques for Pathological Identification]**

#### **Unit – I: Clinical Biochemistry –I [10 Marks]**

Normal function and clinical significance of creatine kinase, lactate dehydrogenase, acid and phosphatases, isocitrate dehydrogenase, amylase, lipase, trypsin, chymotrypsin, choline esterase, glutamate dehydrogenase, glucose-6-phosphate dehydrogenase and ceruloplasmin, Regan isozymes

#### **Unit – II: Clinical Biochemistry – II [10 Marks]**

Normal function and pathophysiological significance of the following blood constituents: glucose, bilirubin, creatine, creatinine, ketone bodies. Minerals and ions: Requirement, function and biological importance and clinical significance of Calcium, Iron, Pathophysiological significance of Lipid and thyroid profile in health. Cardiac Troponins. Liver function test. Kidney function test. Cardiac function test.

#### **Unit – III: Laboratory Automation, Management and Safety [10 Marks]**

Principle, working, care & maintenance and calibration of Weighing balance, Hotplate, Magnetic stirrer, Centrifuges, Incubator, Hot air oven, Colorimeter, Spectrophotometer, Water distillation plant, Deionizers, Laboratory information systems, Types of Automation, Individual steps in the analytical processes, Reagent handling and storage, reagent delivery, Chemical reaction phase, Development of standards for laboratory automation. Other areas of automation; urine analyzers, hematology cell counters and flow-cytometers. Quality Assurance & Management: Fundamentals of total quality management, elements of quality assurance program. External quality assessment-Identifying the source of analytical errors. Biomedical waste management, Fundamentals of Lab Safety.

#### **Unit – IV: Histological Techniques for Pathological Identification - I [10 Marks]**

Tissue fixation: Objectives, Methods, Fixatives, Types, composition and chemistry of fixation. Physical methods: Freezing and microwave fixation; choice of fixatives, Fixation artifacts. Dyes: Types (Natural and synthetic), classification. Different methods of decalcification and their effects on staining. Microtomy: working principle and use of various types of microtomes, preparation of thin section, step section and serial section, practical difficulties in section cutting and their troubleshooting.



**Unit – V: Histological Techniques for Pathological Identification - II [10 Marks]**

Theory and practice of staining, principle and applications of different staining methods. Recognition of artifacts in section.

Principle, procedure and importance of staining techniques: Progressive, regressive, vital, supravital staining, types of Haematoxylin, Haematoxylin-Eosin staining, PAS staining, methylene blue staining. Morphological alterations in cells due to disease, types of degeneration-clouding, hyaline, hydropic and fatty degeneration. Etiology, pathogenesis and histopathology of liver cirrhosis.

**DISTRIBUTION OF QUESTIONS IN THEORETICAL PAPER**

1. From each unit, one question of **10 marks** each with one alternative are to be set. The **10 marks** questions may be subdivided.
2. Candidates have to **attempt all the five** questions.

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

**Unit I:**

1. Estimations of Cholesterol, Triglyceride, HDL and LDL 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).

**DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER**

[Experiment: 30 (15 marks from each unit), *Viva-Voce*: 10, Laboratory Note Book: 10]

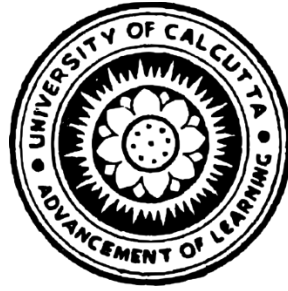
**NOTE:**

1. *For Honours Course, first four (04) Major Papers will be Minor Papers.*
2. *The first four (04) Papers of Core/Minor subjects of Three years Multidisciplinary (MDC) will be the same as the four (04) Minor papers offered in the Four years B.Sc. (Honours & Honours with Research) Course of studies (under CCF,2022) in Physiology.*

**Suggested Readings:**

1. Text book of Medical Physiology, by A.C. Guyton. W.B. Saunders Co.
2. Best & Taylor's Physiological Basis of Medical Practice, O.P.Tandon & Y.Tripathi, Lippincott Williams & Wilkins
3. Ganong's Review of Medical Physiology. Barrett et.al, McGraw Hill Lange
4. Harper's Illustrated Biochemistry, V.W. Rodwell and others, Lange
5. Lehninger's Principles of Biochemistry. By D.L. Nelson and M. M. Cox, Worth Publishers Inc.
6. Textbook of Medical Physiology, D.Venkatesh & H.H.Sudhakar, Wolters Kluwer
7. Text Book of Biochemistry, by E.S. West. W.R. Todd. H.S. Mason. J.T. Van Bruggen. The Macmillan Company.
8. Biochemistry, D.Das, Academic Publishers.
9. Biophysics and Biophysical Chemistry, D.Das. Academic Publishers.
10. Samson Wright's Applied Physiology, C.A. Keele. E Neil & N. Toels. Oxford University Press.
11. Physiology, R.M. Berne & M.N. Levy, C.V. Mosby Co.
12. Basic Histology, L.C. Junqueira & J Carneiro, McGraw- Hill .
13. diFiore's Atlas of Histology, V.P. Eroschenko, Wolters-Kluwer
14. The Cell – A Molecular Approach, G.M. Cooper & R.E.Hausman, ASM Press SINAUER.
15. Cell Biology, G.Karp, John Wiley & Sons, Inc.
16. Core Text Book of Neuro-Anatomy, by M.B. Carpenter; the Williams and Wilkins Company.
17. The Human Nervous System, by Charles Nobach, Mc Graw Hill Book Co.
18. The Human Nervous System. By M.L. Barr & J.A. Kierman, Harper & Row.
19. Essential Food and Nutrition, by M. Swaminathan. The Bangalore Printing & Publishing Co.
20. Cell & Molecular Biology, EDP De Robertis & EMF De Robertis; Lea & Febiger
21. Molecular Biology of the Gene, by J.D. Watson, H.H. Nancy & others; Benjamin Cummings.
22. Molecular Biology of the Cell, B. Alberts and others, Garland.
23. Textbook of Medical Physiology, Indu Khurana, Elsevier
24. Textbook of Medical Biochemistry, R.Chawla et.al , Wolters-Kluwer
25. Biochemistry, J.M.Berg, J.L. Tymoczko & L. Stryer, W.H. Freeman
26. William's Text Book of Endocrinology Larsen et. al An Imprint of Elsevier.
27. Endocrinology, Mac E. Hadley, Pearson Education.
28. Vander's Human Physiology, E.P. Widmaier et al., McGraw-Hill, Higher Education.
29. Concise Medical Physiology by S.K. Chaudhuri, New Central Book Agency.
30. Medical Physiology by A.B. Mahapatra, Current Books International.
31. Endocrinology. Vols.I , II and III by L.O. DeGroot. W.B. Saunders Co.
32. Langman's Medical Embryology by J.W. Sadler, Lippincott Williams and Wilkins.
33. Essentials of Human Embryology by A.K. Datta. Current Books International.
34. Human Embryology by I. Singh & G.P.Pal, McMillan.
35. Human Physiology An Integrated Approach by D.U. Silverthorn, Pearson.
36. Practical Haematology . Dacie and Lewis, Churchill & Livingstone, 10th edition.
37. Essential Haematology . A.V. Hoffbrand, JE Pettit, PHA Moss and Hoffbrand V. 4<sup>th</sup> edition. Blackwell Scientific Publications
38. Ronald Hoffman, Edward J. Benz Jr., Leslie E. Silberstein, Helen Heslop, Jeffrey Weitz, John Anastasi - Hematology: Basic Principles and Practice, Elsevier Health Sciences.

39. Essentials of Biostatistics and Research Methodology by Indranil Saha and Bobby Paul, 4<sup>th</sup> Edition, Academic Publishers.



# UNIVERSITY OF CALCUTTA

**First Year Two Semesters (1<sup>st</sup> & 2<sup>nd</sup> Semester)  
Syllabi of Three Years B.Sc. (Multidisciplinary  
Courses in Studies under Curriculum and Credit  
Framework, 2022)**

**In  
Physiology**

**2023**

**Course and Curriculum**  
**w. e. f. 2023-2024**  
**Subject: PHYSIOLOGY (PHY)**  
**Level: Under Graduate**

**Name of the Programme: 3 Years B.Sc. (Multidisciplinary Courses in Studies under Curriculum and Credit Framework, 2022) in Physiology**

**Programme Specific Objectives:**

The primary objective of the course is to know the 'Human Body' as the most resourceful creation of the nature. It basically focuses on the structural and functional inter-relationship of different systems, their molecular integration, actions and reactions under different internal and external factors and conditions, the remedies including the modern concepts and technologies to combat any biomedical threat on man and mankind.

**Outcome of the programme:**

- Units of a Physiological system and its molecules, Indian contributions. Intercommunications within human system, Basic internal Modulators and Parametric control system.
- Fluid tissues, Fluid Connectivity, Effects of fluid pumping system, and Basic operating systems of life and their functioning
- Supply and Requirements of Essentials from outside and their effects.
- Technology for recording, screening and estimating the different aspects of the Physiological system and allied.
- Human genome and all molecular basics along with specific biomolecular contributions required for physiological system development.
- Pathogens and environments as affecting human health and its manifestations: their trends and interference in deadly diseases and possible remedial measures.
- The ergonomic aspects and issues related to human and its system.
- Yoga for holistic up keeping of both neuronal and physical health. Sports and exercise physiological aspects for future development of physical ability with in depth scientific inputs inclusive for society.
- Advanced technologies, Instruments and methodologies for identification, stage differentiation, determination of different chronic, acute and critical diseases.
- A vision towards the modern approach of the subject for advancement of research and future orientation for the long term benefit of the society.

**Basic Structural Framework of the Syllabus  
CORE COURSES (CC), THEORY (TH), PRACTICAL  
(PR), INTERDISCIPLINARY COURSES (IDC), SKILL  
ENHANCEMENT COURSES (SEC)**

**CORE COURSES (CC):**

Course Code	Subject of the Course	Distribution of Credit		Total Credit	Marks
		TH	PR		
<b>Semester - I</b>					
PHY-CC11-TH-P01	<b>Theory</b> (History of Physiology and medicine and contribution of Indian Scientists in the field of Physiology and allied health sciences, Brief overview of Physiological Systems, Cellular Basis of Physiology, Cellular transport, Chemistry of Biomolecules).	03	00	03	75
PHY-CC11-PR-P02	<b>Practical</b> (History of Physiology and medicine and contribution of Indian Scientists in the field of Physiology and allied health sciences, Brief overview of Physiological Systems, Cellular Basis of Physiology, Cellular transport, Chemistry of Biomolecules).	00	01	01	25
<b>Total</b>		<b>03</b>	<b>01</b>	<b>04</b>	<b>100</b>
<b>Semester - II</b>					
PHY-CC21-TH-P03	<b>Theory</b> (Cell signaling, Enzymes, Biophysical principles).	03	00	03	75
PHY-CC21-PR-P04	<b>Practical</b> (Cell signaling, Enzymes, Biophysical principles).	00	01	01	25
<b>Total</b>		<b>03</b>	<b>01</b>	<b>04</b>	<b>100</b>

**Interdisciplinary Courses (IDC)**

Course Code	Subject of the Course	Distribution of Credit		Total Credit	Marks
		TH	PR		
<b>Semester - I</b>					
HPY-IDC11-TH-P01	<b>Theory</b> (Cellular Basis of Physiology, Biophysical Principles, Enzymes, Bio-	02	00	02	50

	molecules, Digestion & Metabolism).				
<b>HPY-IDC11-PR-P02</b>	<b>Practical</b> ( Cellular Basis of Physiology, Biophysical Principles, Enzymes, Bio-molecules, Digestion & Metabolism)	<b>00</b>	<b>01</b>	<b>01</b>	<b>25</b>
	<b>Total</b>	<b>02</b>	<b>01</b>	<b>03</b>	<b>75</b>
	<b>Semester - II</b>				
<b>HPY-IDC21-TH-P03</b>	<b>Theory</b> (Blood and Body Fluids, Cardiovascular System, Respiratory System, Nerve-muscle Physiology, Renal Physiology).	<b>02</b>	<b>00</b>	<b>02</b>	<b>50</b>
<b>HPY-IDC21-PR-P04</b>	<b>Practical</b> ( Blood and Body Fluids, Cardiovascular System, Respiratory System, Nerve-muscle Physiology, Renal Physiology)	<b>00</b>	<b>01</b>	<b>01</b>	<b>25</b>
	<b>Total</b>	<b>02</b>	<b>01</b>	<b>03</b>	<b>75</b>

### Skill Enhancement Courses (SEC)

Course Code	Subject of the Course	Distribution of Credit		Total Credit	Marks
		TH	PR		
<b>PHY-SEC-TH-P01</b>	<b>Theory</b> (Clinical Biochemistry, Age Related Health Issues, Clinical Haematology, Applied Work and Exercise Physiology)	<b>02</b>	<b>00</b>	<b>02</b>	<b>50</b>
<b>PHY-SEC-PR-P02</b>	<b>Practical</b> (Clinical Biochemistry, Age Related Health Issues, Clinical Haematology, Applied Work and Exercise Physiology)	<b>00</b>	<b>02</b>	<b>02</b>	<b>50</b>
	<b>Total</b>	<b>02</b>	<b>02</b>	<b>04</b>	<b>100</b>

## **CORE COURSES (CC)**

### **Semester - I**

**Total credit – 04 (Theory - 03, Practical - 01); Total marks: 100**

**Course – I: Theory, Paper Code: PHY-CC11-TH-P01 [Credit: 03; Marks: 75]**

**[History of Physiology and medicine and contribution of Indian Scientists in the field of Physiology and allied health sciences, Cellular Basis of Physiology, Cellular transport, Chemistry of Biomolecules]**

**Unit - I: History of Physiology and medicine and contribution of Indian Scientists in the field of Physiology and allied health sciences and Brief Overview of Physiological Systems [15 Marks]**

History of Physiology and medicine and contribution of Indian Scientists in the field of Physiology and allied health sciences:

Subodh Chandra Mahalanobis, Sacchidananda Banerjee, Dilip Mahalanabis, Autar Singh Paintal, John Burdon Sanderson Haldane, Upendra Nath Brahmachari.

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 - I [15 Marks]**

Carbohydrates: Definition and classification. Monosaccharides – Classification, structure, stereoisomerism, optical isomerism, optical activity, epimerism. Cyclic structures- Pyranose and furanose forms, anomers, 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.

#### **Unit – IV: Chemistry of Biomolecules - II [15 Marks]**

Lipids:Definition and classification. Fatty acids - Classification, systematic 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.

#### **Unit – V: Chemistry of Biomolecules - III [15 Marks]**

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 ( $\alpha$ -helix and  $\beta$ -pleated sheet), Tertiary and Quaternary.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.

#### **DISTRIBUTION OF QUESTIONS IN THEORETICAL PAPER**

1. From each unit, one question of **15 marks** each with one alternative are to be set. The **15 marks** questions may be subdivided.
2. Candidates have to **attempt all the five** questions.

**Course – II: Practical, Paper Code: PHY-CC11-PR- P02 [Credit: 01; Marks: 25]**

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.

**DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER**

[Experiment: 15, Viva-Voce:05, Laboratory Note Book:05]

**Semester-II**

**Total credit – 04 (Theory-03, Practical-01) Total marks: 100**

**Course – III: Theory, Paper Code: PHY-CC21-TH-P03 [Credit: 03; Marks: 75]**

**[Cell signaling, Enzymes, Biophysiochemical principles]**

**Unit – I: Cell signaling [15 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, IP<sub>3</sub>, DAG, Protein kinases, Ca<sup>2+</sup>, CO, NO. Signal transduction pathways: Phosphatidylinositides, MAP kinase, JAK-STAT, Raf-Ras, SMAD.

**Unit – II: Enzyme – I [15 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 (K<sub>m</sub>), 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 K<sub>m</sub> and V<sub>max</sub>.

**Unit – III: Enzyme – II [15 Marks]**

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. Feed-back inhibition. Rate-limiting enzymes and its features, multienzymes, Isozymes, Ribozymes and Abzymes.

#### **Unit – IV: Biophysics and Biophysical Principles - I [15 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.

#### **Unit – V: Biophysics and Biophysical Principles – II [15 Marks]**

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.

#### **DISTRIBUTION OF QUESTIONS IN THEORETICAL PAPER**

1. From each unit, one question of **15 marks** each with one alternative are to be set. The **15 marks** questions may be subdivided.
2. Candidates have to **attempt all the five** questions.

#### **Course – IV: Practical, Paper Code: PHY-CC21-PR- P04 [Credit: 01; Marks: 25]**

1. 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. Study of charts on Cell signaling

**Demonstration:** Preparation of Buffer and pH measurement.

#### **DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER**

**[Experiment: 15, Viva-Voce: 05, Laboratory Note Book:05]**

## INTERDISCIPLINARY COURSES (IDC)

### SEMESTER - I

**Total Credit: 3 [Theory: 2, Practical: 1], Full Marks:75**

**Course: Theory, Paper Code: PHY- IDC11-TH-P01 [Credit: 02; Marks: 50]  
[Cellular Basis of Physiology, Biophysical Principles, Enzymes, Bio-molecules, Digestion & Metabolism]**

#### **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, metalloenzymes, 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.

**DISTRIBUTION OF QUESTIONS IN THEORETICAL PAPER**

1. From each unit, one question of **10 marks** each with one alternative are to be set. The **10 marks** questions may be subdivided.
2. Candidates have to **attempt all the five** questions.

**Course: Practical, Paper Code: PHY- IDC11-PR-P02 [Credit: 01; Marks: 25]**

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

**2.Qualitative tests for identification of :** Glucose, Fructose, Lactose, Sucrose, Starch, Dextrin, Lactic acid, Hydrochloric acid , urea, Albumin, peptone, Acetone, Glycerol and Bile Salts.

**3.Quantitative estimation** of ammonia and amino nitrogen by Sorensen's formol titration method (percentage and total to be done)

**DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER**

**[Experiment: 15, Viva-Voce: 05, Laboratory Note Book:05]**

## SEMESTER - II

**Total Credit: 3 [Theory: 2, Practical: 1], Full Marks:75**

**Course: Theory, Paper Code: PHY- IDC21-TH-P03 [Credit: 02; Marks: 50]**

**[Blood and Body Fluids, Cardiovascular System, Respiratory System, Nerve-muscle Physiology, Renal Physiology]**

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

Composition and functions of Plasma proteins: origin and functions. Blood cells-- their morphology and functions. Erythropoiesis. 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. 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. indefatigability. 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.

### **DISTRIBUTION OF QUESTIONS IN THEORETICAL PAPER**

1. From each unit, one question of **10 marks** each with one alternative are to be set. The **10 marks** questions may be subdivided.
2. Candidates have to **attempt all the five** questions.

**Course: Practical, Paper Code: PHY- IDC21-PR-P04 [Credit: 01; Marks: 25]**

1. Preparation and staining of human blood film with Leishman's stain and identification of different types of blood cells.
2. Determination of haemoglobin by Shali's haemoglobinometer, bleeding time and Clotting time determination.
3. Measurement of systolic and diastolic pressure by sphygmomanometer and determination of pulse pressure and mean pressure by auscultatory method.
4. Pneumographic recording of normal respiratory movements and effects of hyperventilation and breath-holding.

**DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER**

**[Experiment: 15, Viva-Voce: 05, Laboratory Note Book: 05]**

## **SKILL ENHANCEMENT COURSES (SEC)**

**Total Credit: 4 [Theory: 2, Practical: 2], Marks: 100**

**Course: Theory, Paper Code: PHY-SEC-TH-P01 [Credit: 02; Marks: 50]**  
**[Clinical Biochemistry, Age Related Health Issues, Clinical Haematology, Applied Work and Exercise Physiology]**

### **Unit – I: Clinical Biochemistry - I [10 Marks]**

Normal function and pathophysiological significance of the following blood constituents: glucose, bilirubin, creatine, creatinine, ketone bodies. Pathophysiological significance of Lipid and thyroid profile in health. Cardiac Troponins. Liver function test. Kidney function test. Cardiac function test.

### **Unit – II: Clinical Biochemistry -II[10 Marks]**

Normal function and clinical significance of creatine kinase, lactate dehydrogenase, phosphatases, isocitrate dehydrogenase, amylase, lipase, trypsin, chymotrypsin, choline esterase, glutamate dehydrogenase, glucose-6-phosphate dehydrogenase, Amylase, Acid and Alkaline phosphatases, GPT, GOT, Lipase,  $\gamma$ -glutamyl transpeptidase, Regan Isoenzymes.

### **Unit – III: Age Related Health Issues [10 Marks]**

Paediatrics Health problems (Respiratory distress syndrome; neonatal hyperbilirubinemia; cystic fibrosis; Down syndrome). Vaccination in Newborn babies, Recommended immunization schedule. Adult health problems (Non alcoholic fatty liver, Atherosclerosis, Obesity, Smoking), Geriatric health problems (Alzheimer disease, Parkinson disease, Osteoarthritis, COPD, Depression and Dementia, Hearing loss, Cataracts and refractive errors).

### **Unit IV: Clinical Haematology [10 Marks]**

Blood groups: ABO and Rh system. Immunological basis of identification of ABO and Rh blood groups. Blood transfusion - precaution and hazards. Concept of Blood Bank. Definition, principle, procedure of determination and pathophysiological significance of TC, DC, ESR, Arneht count, PCV, MCV, MCH, MCHC, bleeding time, clotting time and prothrombin time. Anaemia - types (definition and causes). Definition, Pathophysiological significance of erythrocytosis, anaemia leucocytosis, leucopenia and Purpura.



**Unit V: Applied Work and Exercise Physiology [10 Marks]**

Definitions of work and exercise Physiology, Fundamental concepts of work, different categories of work. Physical work—its definition and nature—isotonic, isometric and isokinetic, positive and negative work.

Physiological basis of work: Concept of physiological work. Power and capacity relation. Work-load – light, moderate (submaximal) and heavy (maximal) depending on intensity and duration of work. Changes in heart rate, oxygen consumption and blood pressure to assess person's ability to withstand work load. Effect of heat stress on physiological responses to work load, Aerobic and anaerobic capacity, EPOC, lactate threshold and lactate tolerance and their usefulness. Athletic performance based on aerobic and anaerobic capacity. Brief general idea about nutritional aspects of sports.

**DISTRIBUTION OF QUESTIONS IN THEORETICAL PAPER**

1. From each unit, one question of **10 marks** each with one alternative are to be set. The **10 marks** questions may be subdivided.
2. Candidates have to **attempt all the five** questions.

**Course: Practical, Paper Code: PHY-SEC-PR-P02 [Credit: 02; Marks: 50]**

**Unit I:** Preparation and staining of blood film with Leishman's stain. Identification of blood cells. Estimation of Haemoglobin by Sahli's haemoglobinometer, Calculation of haematological indices (MCV, MCH, MCHC), Determination of Clotting time and Bleeding time, ESR.

**Unit II:** Determination of BMI, BSA, PI, waist hip ratio, 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.

**Demonstration:**

Estimation of blood glucose by GOD-POD method, Serum cholesterol, SGPT, SGOT, serum alkaline phosphatase by standard biochemical kit.

**DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER**

[Experiment: 30 (15 marks from each unit), Viva-Voce: 10, Laboratory Note Book: 10]

**NOTE:**

***1. For Honours Course, first four (04) Major Papers will be Minor Papers.***

***2. The first four (04) Papers of Core/Minor subjects of Three years Multidisciplinary (MDC) will be the same as the four (04) Minor papers offered in the Four years B.Sc. (Honours & Honours with Research) Course of studies (under CCF,2022) in Physiology.***

**Suggested Readings:**

1. Text book of Medical Physiology, by A.C. Guyton. W.B. Saunders Co.
2. Best & Taylor's Physiological Basis of Medical Practice, O.P.Tandon & Y.Tripathi, Lippincott Williams & Wilkins
3. Ganong's Review of Medical Physiology. Barrett et.al, McGraw Hill Lange
4. Harper's Illustrated Biochemistry, V.W. Rodwell and others, Lange
5. Lehninger's Principles of Biochemistry. By D.L. Nelson and M. M. Cox, Worth Publishers Inc.
6. Textbook of Medical Physiology, D.Venkatesh & H.H.Sudhakar, Wolters Kluwer
7. Text Book of Biochemistry, by E.S. West. W.R. Todd. H.S. Mason. J.T. Van Bruggen. The Macmillan Company.
8. Biochemistry, D.Das, Academic Publishers.
9. Biophysics and Biophysical Chemistry, D.Das. Academic Publishers.
10. Samson Wright's Applied Physiology, C.A. Keele. E Neil & N. Toels. Oxford University Press.
11. Physiology, R.M. Berne & M.N. Levy, C.V. Mosby Co.
12. Basic Histology, L.C. Junqueira & J Carneiro, McGraw- Hill .
13. diFiore's Atlas of Histology, V.P. Eroschenko, Wolters-Kluwer
14. The Cell – A Molecular Approach, G.M. Cooper & R.E.Hausman, ASM Press SINAUER.
15. Cell Biology, G.Karp, John Wiley & Sons, Inc.
16. Core Text Book of Neuro-Anatomy, by M.B. Carpenter; the Williams and Wilkins Company.
17. The Human Nervous System, by Charles Nobach, Mc Graw Hill Book Co.
18. The Human Nervous System. By M.L. Barr & J.A. Kierman, Harper & Row.
19. Essential Food and Nutrition, by M. Swaminathan. The Bangalore Printing & Publishing Co.
20. Cell & Molecular Biology, EDP De Robertis & EMF De Robertis; Lea & Febiger
21. Molecular Biology of the Gene, by J.D. Watson, H.H. Nancy & others; Benjamin Cummings.
22. Molecular Biology of the Cell, B. Alberts and others, Garland.
23. Textbook of Medical Physiology, Indu Khurana, Elsevier
24. Textbook of Medical Biochemistry, R.Chawla et.al , Wolters-Kluwer
25. Biochemistry, J.M.Berg, J.L. Tymoczko & L. Stryer, W.H. Freeman
26. William's Text Book of Endocrinology Larsen et. al An Imprint of Elsevier.
27. Endocrinology, Mac E. Hadley, Pearson Education.

28. Vander's Human Physiology, E.P. Widmaier et al., McGraw-Hill, Higher Education.
29. Concise Medical Physiology by S.K. Chaudhuri, New Central Book Agency.
30. Medical Physiology by A.B. Mahapatra, Current Books International.
31. Endocrinology. Vols.I, II and III by L.O. DeGroot. W.B. Saunders Co.
32. Langman's Medical Embryology by J.W. Sadler, Lippincott Williams and Wilkins.
33. Essentials of Human Embryology by A.K. Datta. Current Books International.
34. Human Embryology by I. Singh & G.P.Pal, McMillan.
35. Human Physiology An Integrated Approach by D.U. Silverthorn, Pearson.
36. Practical Haematology . Dacie and Lewis, Churchill & Livingstone, 10th edition.
37. Essential Haematology . A.V. Hoffbrand, JE Pettit, PHA Moss and Hoffbrand V. 4<sup>th</sup> edition. Blackwell Scientific Publications
38. Ronald Hoffman, Edward J. Benz Jr., Leslie E. Silberstein, Helen Heslop, Jeffrey Weitz, John Anastasi - Hematology: Basic Principles and Practice, Elsevier Health Sciences.
39. Essentials of Biostatistics and Research Methodology by Indranil Saha and Bobby Paul, 4<sup>th</sup> Edition, Academic Publishers.