



UNIVERSITY OF CALCUTTA

Notification No. CSR/83/2024

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 the exercise of her powers under 9(6) of the said Act, the Vice-Chancellor has, by an order dated 20.09.2024, approved the syllabus (Semester-3 & 4) of Physiology (4-year Honours & Honours with Research, 3-year MDC & Minor), under this University as laid down in the accompanying Pamphlet.

The new CSR shall take effect from the Odd semester examination, 2024 and onwards.

SENATE HOUSE

Kolkata-700073

26.09.2024

A handwritten signature in blue ink, appearing to read 'D 26/9/2024'.

Prof.(Dr.) Debasis Das

Registrar



UNIVERSITY OF CALCUTTA

**Second Year Two Semesters (Semester – III
& Semester – IV) Syllabi of Four Years B.Sc.
(Honours & Honours with Research) Courses in
Studies (Under Curriculum and Credit
Framework, 2022)**

In

Physiology

2024

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

CORE COURSES (CC):

Course Code	Subject of the Course	Distribution of Credit		Total Credit	Marks
		TH	PR		
SEMESTER - III					
PHY-CC31-TH-P05	Theory (Blood and Body Fluids, Cardiovascular Physiology, Respiratory Physiology, Digestive System, Excretory Physiology)	03	00	03	75
PHY-CC31-PR-P06	Practical (Blood and Body Fluids, Cardiovascular Physiology, Respiratory Physiology, Digestive System, Excretory Physiology)	00	01	01	25
PHY-CC32-TH-P07	Theory (Nerve Muscle Physiology, Nervous System, Special Senses, Introduction to Biostatistics)	03	00	03	75
PHY-CC33-PR-P08	Practical (Nerve Muscle Physiology, Nervous System, Special Senses, Introduction to Biostatistics)	00	01	01	25
Total		06	02	08	200
Skill Enhancement Courses (SEC)					
PHY-SEC31-TH-P03	Theory (Applied Physiology and Basic Techniques)	02	00	02	50
PHY-SEC31-PR-P04	Practical (Applied Physiology and Basic Techniques)	00	02	02	50
Total		02	02	04	100
SEMESTER - IV					

PHY-CC41-TH-P09	Theory (Applied Hematology, Cardiovascular Disorders, Diseases of GI System & Excretory System and Bioinformatics)	03	00	03	75
PHY-CC41-PR-P10	Practical (Applied Hematology, Cardiovascular Disorders, Diseases of GI System & Excretory System and Bioinformatics)	00	01	01	25
PHY-CC42-TH-P11	Theory (Bioenergetics, Metabolism and Common Metabolic Disorders)	03	00	03	75
PHY-CC42-PR-P12	Practical (Bioenergetics, Metabolism and Common Metabolic Disorders)	00	01	01	25
PHY-CC43-TH-P13	Theory (Foundations of Endocrine and Reproductive Physiology, Nutrition and Dietetics, Basic Bacteriology, Basic Immunology)	03	00	03	75
PHY-CC43-PR-P14	Practical (Foundations of Endocrine and Reproductive Physiology, Nutrition and Dietetics, Basic Bacteriology, Basic Immunology)	00	01	01	25
PHY-CC44-TH-P15	Theory (Chronobiology & Stress Physiology, Aviation & Space Physiology, Stem cell Biology, Biostatistics, Computer and its application)	03	00	03	75
PHY-CC44-PR-P16	Practical (Chronobiology & Stress Physiology, Aviation & Space Physiology, Stem cell Biology, Biostatistics, Computer and its application)	00	01	01	25
	Total	12	04	16	400

Note: Students who will opt other than Physiology as major in combination with minor Physiology in Semester – I and in Semester – II will take CC11 (*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*) and CC21 (*Cell signaling, Enzymes, Biophysicochemical principles*) in Semester – I and in Semester – II, respectively.

Students who will opt other than Physiology as major in combination with minor as Physiology in Semester – III and in Semester – IV, they will take CC11 (*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*) and CC21 (*Cell signaling, Enzymes, Biophysicochemical principles*) as minor Physiology in Semester – III and in Semester – IV, respectively as published in the University of Calcutta, Notification No. CSR/13/2023 dated 12/07/2023.

CORE COURSES (CC)

SEMESTER - III

Total credit – 08 (Theory-06, Practical-02) Total marks: 200

Course – V: Theory, Paper Code: PHY-CC31-TH-P05 [Credit: 03; Marks: 75]
[Blood and Body Fluids, Cardiovascular Physiology, Respiratory Physiology, Digestive System, Excretory Physiology]

Unit – I: Blood and Body Fluids – I [15 Marks]

Bone marrow. Formed elements of blood: origin, formation, functions and fate. Plasma proteins—normal values, origin and functions. Erythropoiesis: Process, Iron-ferritin-transferrin system, Role of folic acid and cyanocobalamin, Role of erythropoietin. Erythrocytes: Structural architecture, Hemoglobin – Structure, reactions, biosynthesis, and catabolism. Foetal Hemoglobin. Abnormal hemoglobins. Different types of anemia and their causes. Leucopoiesis. Leukocytes: Lymphocytes, mast cells, plasma cells, macrophages and their involvement in

immune network; Blood volume: normal values, regulation and determination by dye and radioisotope methods.

Unit – II: Cardiovascular Physiology - I [15 Marks]

Anatomy of the heart. Properties of cardiac muscle. Origin and propagation of cardiac impulse. Cardiac cycle: Events. Pressure and volume changes. Heart sounds. Murmurs. Cardiac output: Measurement by application of Fick's principle & factors affecting. Starling's law of heart. Blood pressure: Types, Factors affecting blood pressure. Electrocardiography: The normal electrocardiogram, electrocardiographic leads, vectorial analysis, the vectorcardiogram and the mean electrical axis of heart. Principles of Echocardiography.

Unit –III: Respiratory Physiology – I [15 Marks]

Anatomy, histology and functional organization of the lungs and airways. Mechanics of breathing: Role of respiratory muscles, glottis. Compliance of lungs and chest wall, pressure-volume relationships, alveolar surface tension and surfactant, work of breathing. Spirometry: Lung volumes and capacities. Dead space. Pulmonary Circulation, Oxygen transport, Carbon-dioxide transport, Ventilation-perfusion ratio.

Unit – IV: Digestive system – I [15 Marks]

Anatomy, histology and functional organization of alimentary canal. Digestive glands – histological structures of salivary glands, pancreas, liver. Deglutition. Movements of alimentary canal and their regulations. Composition, functions and regulation of the secretion of salivary, gastric, pancreatic and intestinal juices and bile. Enterohepatic circulation. Carbohydrate, lipid, protein digestion and absorption, GALT.

Unit- V: Excretory Physiology – I [15 Marks]

Kidney: Anatomy and functional organization of kidney. Histology of nephron. Renal circulation – peculiarities and autoregulation. Formation of urine – glomerular function and tubular functions. Countercurrent multiplier and exchanger. Renal regulation of osmolarity and volume of blood fluids. Diabetes insipidus. Formation of hypertonic urine. Renal regulation of acid-base balance, acidification of urine. Structure and functions of skin. Sweat glands. Insensible and sensible perspiration. Regulation of body temperature -- physical and physiological processes involved in it. Physiology of sweat secretion and its regulation. Pyrexia, hyperthermia and hypothermia.

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 – VI: Practical, Paper Code: PHY-CC31-PR- P06 [Credit: 01; Marks: 25]

1. **Haematological experiments:** Preparation and staining of blood film with Leishman's stain. Identification of blood cells. Total count of W.B.C. and R.B.C. Differential count of W.B.C. Hemoglobin estimation by Drabkin's Method. Preparation of hemin crystals.
2. **Postural Effects on Blood Pressure:** Effects of sitting, lying, and standing postures on arterial blood pressure.
2. **Respiratory Revelations:** Pneumographic recording of effects of hyperventilation, breath-holding and talking. Lung function tests using Spirometry (Digital) and analysis of the results.
4. **E.C.G:** Recording and analysis of the normal tracing.

Demonstration: Palpation of arterial pulse from Radial, Brachial, Popliteal, Dorsalis pedis and determination of pulse count.

DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER

[Experiment: 15, Viva-Voce: 05, Laboratory Notebook: 05]

**Course – VII: Theory, Paper Code: PHY-CC32-TH-P07 [Credit: 03; Marks: 75]
[Nerve Muscle Physiology, Nervous System, Special Senses, Introduction to Biostatistics]**

Unit – I: Nerve Muscle Physiology – I [15 Marks]

Nerve: Structure, classification and functions of neurons and neuroglia. Cytoskeletal elements and axoplasmic flow. Myelinogenesis. The resting membrane potential. The action potential. Propagation of nerve impulse. Properties of nerve fibers: excitability, conductivity, all or none law, accommodation, adaptation, summation, refractory period, indefatigability. Chronaxie, rheobase and utilization time. Muscle: Microscopic and electron microscopic structure of skeletal, smooth and cardiac muscles. The sarcomere system. Red and white striated muscle fibers. Single-unit and multi-unit smooth muscle. Muscle groups: antagonists and agonists. Properties of muscles: all or none law, beneficial effect, summation, refractory period, tetanus, fatigue, Synapses: Definition, types, structure,

Unit – II: Nervous System – I [15 Marks]

Anatomy and structural organization of different parts of the brain and spinal cord. A brief outline of the organization and basic functions (sensory, motor, and association) of the nervous system, central and peripheral nervous system. Ascending tracts carrying touch, kinaesthetic,

temperature, and pain sensations. Descending tracts: pyramidal tract and a brief outline of the extrapyramidal tracts. Reflex action - definition, reflex arc, classification, properties. Functions of the spinal cord. CSF: composition, formation, circulation, and functions.

Unit – III: Special Senses – I [15 Marks]

Special Sense Organ-Characteristics of Special Senses, Sensory Coding- Weber-Fechner Law, Steven's Power Law. Audition- Structure of ear, Auditory pathway, and center, Mechanism of Hearing, Discrimination of sound frequencies and intensities. Localization of sound source. Deafness. Olfaction and Gustation- Structure of sense organ. Neural pathway of Olfactory and Gustatory sensation and centers. Mechanism of Olfactory and Gustatory sensation. Olfactory and Gustatory Adaptation. After taste.

Unit– IV: Special Senses –II [15 Marks]

Vision- Structure of Eyeball, Histological details of Retina, Fovea, and blind spot. Visual pathway and centers. Accommodation. Errors of refraction. Formation and Circulation of Aqueous Humour and Vitreous Humour. Photopic and scotopic vision. Chemical and electrical changes in the retina on exposure to light. Visual processing in the retina. Positive and negative after-images. Contrast phenomenon. Light and dark adaptation. Colour vision—Trichromatic, Single and Double Opponent mechanism. Colour blindness. Visual field-- perimetry. Visual acuity – measurement, mechanism and factors affecting.

Unit –V: Biostatistics – I [15 Marks]

Scope of statistics – utility and misuse. Principles of statistical analysis of biological data. Basic concepts – variable. Population and Sampling -- parameter, statistic. Presentation of data- frequency distribution, frequency polygon, histogram, bar diagram, and pie diagram. Different classes of statistics- mean median, mode, mean deviation, variance, standard deviation, standard error of the mean. Standard score.

DISTRIBUTION OF QUESTIONS IN THEORETICAL PAPER

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

Course- VIII: Practical, Paper Code: PHY-CC32-PR- P08 [Credit: 01; Marks: 25]

- 1(a) Staining of isolated nerve fiber by silver nitrate method.
- (b) Staining of skeletal & cardiac muscle by methylene blue

- 2(a) Determination of Visual Acuity by Snellen's Chart
- (b) Determination of Colour Blindness by Ishihara Chart
- (c) Determination of Deafness by Tuning Fork Tests.

3. Computation of mean, median, mode, standard deviation and standard error of the mean with physiological data like body temperature, pulse rate, respiratory rate, height and weight of human subjects.

Demonstration:

1. Study and use of Kymograph, induction coil, key
2. Gastrocnemius-sciatic nerve preparation and kymographic recording of isotonic muscle twitch
3. Demonstration of medically important technique: EMG.

DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER

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

**SKILL ENHANCEMENT COURSE (SEC)
SEMESTER – III
SEC-3**

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

**Course: Theory, Paper Code: PHY-SEC31TH--P03
[Credit: 02; Marks: 50]**

[Applied Physiology and Basic Techniques]

Group –A [50 Marks]

Unit – I: Community and Public Health– I [10 Marks]

Basic idea about community, and public health issues. Malnutrition in a community, overnutrition, and possible remedial measures. Diet management of obese, diabetic, and athletes. Population problem – principles and methods of family planning. Problem of Infertility and Assisted Reproductive Technologies. Principles and social importance of 19 immunization against diseases. Etiology, epidemiology, and prevention -- Communicable diseases: Cholera, Malaria, Dengue, Hepatitis and AIDS; Non-communicable diseases – Hypertension and Obesity.

Unit –II: Detection & Prevention of Common Microbes [10 Marks]

Classification of microorganisms: Techniques employed for the identification of microorganisms -- microscopic and biochemical methods. Control of microbial growth: Physical and Chemical methods used in sterilization, disinfection, and pasteurization Food microbiology: Beneficial and harmful microorganisms in food, causative organisms of food-borne infections- mode of transmission and methods of Prevention.

Unit –III: Basics of Ergonomics & Its Application Introduction to Ergonomics [10 Marks]

Definition, Domain and scope of ergonomics. Role of ergonomics in health, safety, industrial productivity and Design. System Design: Human - machine interaction. Cognitive Ergonomics and its role in Design.

Anthropometric considerations in Ergonomics: Definition of anthropometry, Anthropometric principles in workplace design, Percentile calculations.

Environmental Ergonomics: Ergonomic consideration of thermal environment, Ergonomic consideration of visual environment, Ergonomic consideration of environmental noise

Ergonomic intervention and its application in real field.

Unit-IV: Nano-bioscience [10 Marks]

Historical perspectives – Definitions and Classifications on the basis of dimension: Zero, One, Two and Three - Quantum dots, Clusters, thin films, Nanowires, Rods and tubes. Nano biomaterials and Biocompatibility: Surface and Bulk Properties of Biomaterials – Nano-biomaterials –Nano-Ceramics – Nano polymers – Nano Silica – Hydroxy apatite – Carbon Based nanomaterials. Fabrication of nanoparticles/nanomaterials: Top-down and Bottom-Up Approaches: Physical, Chemical and Biological Routes.

Unit–V–Computer & Its Application in Physiology – I [10 Marks]

Basic Architecture of Computer: Central Processing Unit (CPU); Peripheral Devices including storage devices. Software and Programming Language: Machine Language; Assembly Language; High Level Language; (FORTRAN, COBOL, C++, UNIX, BASIC), Statistical packages.

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-SEC31PR-P04

[Credit: 02; Marks: 50]

[Applied Physiology and Basic Techniques]

Group –B [50 Marks]

1. Field Survey Report on a comparative study of different physiological parameters (at least two parameters, their effects or variations in different community/population various conditions (at least one condition) using any suitable methodology.
2. Biochemical tests to identify microbe: Oxidase test, Catalase test.
- 3 (a) Determination of heat stress by WBGT indices.
(b) Assessment of illumination.
(c) Measurement of some common anthropometric parameters: stature, eye height, shoulder height, elbow height, sitting height, knee height, shoulder elbow length, arm reach from the wall, Head circumference and neck circumference, and mid-arm circumference.
- 4.(a). Fabrication of Au/Ag metal nanoparticles by biological route.
(b) Optical properties of Au/Ag nanoparticles by using UV-Vis spectroscopy.
5. Preparation of Curriculum Vitae (CV), Using MS Word. Preparation of a few standard statistical diagrams.

Demonstrations:

1. Sterilization Methods (autoclaving, dry heat)
2. Handling and storage of microbial samples.
3. General microbes waste disposal protocol & biosafety of microbiology laboratory

DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER

[Experiment:25, Field Survey: 10, Viva-Voce: 10, Laboratory Note Book: 05.]

SEMESTER - IV

Total credit – 16 (Theory-12, Practical-04) Total marks: 400

Course – IX: Theory, Paper Code: PHY-CC41-TH-P09 [Credit: 03; Marks: 75]

[Applied Hematology, Cardiovascular Disorders, Diseases of GI System & Excretory System and Bioinformatics]

Unit-I: Applied Hematology, Blood & Body fluids - II [15 Marks]

Hemostasis – factors, mechanism, anticoagulants, procoagulants, Fibrinolysis, Pathogenesis of Thrombosis & Thrombolytic agents. Disorders of hemostasis-hemophilia, Thrombosis and Embolism. Definition, determination, and significance of TC, DC, ESR, Arneht count, PCV, MCV, MHC, MCHC, bleeding time, clotting time, and prothrombin time. Blood group: ABO and Rh systems (Chemical nature of relevant biomolecules). Erythroblastosis Fetalis. Blood transfusion and its hazards. Lymph and tissue fluids: Formation, circulation, functions and fate. Lymphatic organs: Histological structures and functions of lymph gland and spleen. Splenomegaly: causes and effects. Circulatory disorder: Oedema, Varicose vein.

Unit II: Cardiovascular Disorders [15Marks].

Cardiac Arrhythmias. Myocardial Infarctions. Coronary Circulation. Myocardial necrosis and Myocarditis: Cardiac Hypertrophy, Heart failure and ischemic heart disease. Coronary bypass, coronary angioplasty. Cytotoxic necrosis. Cardiotoxins – important cardiotoxic substances.

Unit –III: Common Diseases of Gastrointestinal & Excretory System [15Marks]

Basic concepts of irritable bowel syndrome (IBS). Gastroesophageal Reflux Disease (GERD). Peptic Ulcer, Jaundice, and Gallstones. ulcerative colitis, appendicitis gastritis, Renal function tests – creatinine, inulin, urea, and PAH clearance tests. Constituents of urine. Abnormal constituents of urine, and pathophysiological significance. Renal dialysis. Non-excretory functions of the kidney. Urinary Tract Infections (UTIs).

Unit--IV: Basic Genetics [15 Marks]

Chromosome: structure and function, Mitosis and meiosis, Crossing over and recombination, Chromosomal Mutations. Chromosomal DNA packaging-nucleosomes and a higher level of organization of chromatin. Euchromatin and heterochromatin. Human genome and its characteristics. Mitochondrial DNA. Epistasis, Penetrance, Expressivity, Pleiotropism. Karyotyping. Molecular Genetics: DNA structure and replication, Gene expression and regulation, Mutation and repair, Gene cloning and sequencing.

Unit-V: Bioinformatics [15 Marks]

Introduction to Bioinformatics, Literature databases (PubMed), Primary nucleotide sequence databases (NCBI, EMBL, DDBJ), Secondary nucleotide sequence databases (UniGene, SGD)

etc.), Protein sequence databases (SwissProt/ TrEMBL, PIR), Sequence motif databases (Pfam, PROSITE), Structure databases (PDB, NSD, SCOP, CATH), Gene Expression databases. Introduction to computational biology- prediction of 3-D protein structure, identification of unknown protein, drug design, and application in medical sciences.

DISTRIBUTION OF QUESTIONS IN THEORETICAL PAPER

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

Course – X: Practical, Paper Code: PHY-CC41-PR- P10 [Credit: 01; Marks: 25]

1. Determination of blood group, bleeding time and clotting time.
2. Qualitative tests to identify Normal & Abnormal constituents of urine:
Normal constitution: Chloride, Sulphate, Phosphate, Creatinine and Urea;
Abnormal constituents of urine: Glucose, Protein, Acetone, Bile pigment and Bile Salt.
3. Retrieval of a particular gene sequence of interest from GenBank.

DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER

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

Course – XI: Theory, Paper Code: PHY-CC42-TH-P11 [Credit: 03; Marks: 75]
[Bioenergetics, Metabolism and Common Metabolic Disorders]

Unit I: Bioenergetics [15 Marks]

Sensors of biological organisms — biological transducers. System, boundary, and surroundings, Energy distribution and transformation, Concepts of free energy sources of life processes. Laws of Thermodynamics as it applies in life systems. Bioenergetics; Redox potential. Mitochondrial Electron Transport Chain. Chemiosmotic hypothesis, Oxidative phosphorylation- inhibitors and uncouplers.

Unit-II: Metabolism-I [15 Marks]

Carbohydrate Metabolism: Glycolysis, R-L cycle. TCA cycle, Gluconeogenesis - Cori cycle, Anaplerotic reactions and Amphibolic nature of TCA cycle. Pentose phosphate pathway. Glycogenesis and Glycogenolysis.

Unit- III: Metabolism-II [15 Marks]

Lipid Metabolism: β -oxidation and biosynthesis of saturated and monounsaturated fatty acids. Biosynthesis of Cholesterol. Ketone body metabolism. (Hormonal regulation of the above-mentioned biochemical pathways is not required.)

Unit-IV: Metabolism – III [15 Marks]

Protein Metabolism: Amino acid pool. Deamination, transamination, amination and decarboxylation. Synthesis of Urea and Nitric oxide. Glucogenic and ketogenic amino acids. Metabolism of Glycine, Phenylalanine. Methionine, Purines and Pyrimidines– Biosynthesis: *de novo* and salvage pathways. Catabolism.

Unit–V: -Common Metabolic Disorders [15 Marks]

Cause, Symptoms and Pathophysiology of Phenylketonuria, Gaucher Disease, Maple syrup urine disease, Hemochromatosis, Abdominal obesity, Fatty liver. Dyslipidemia, Lysosomal storage disorder, Krabbe disease. Wilson disease, Cystic fibrosis, Hyper and Hypothyroidism,

DISTRIBUTION OF QUESTIONS IN THEORETICAL PAPER

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

Course – XII: Practical, Paper Code: PHY-CC42-PR- P12 [Credit: 01; Marks: 25]**Biochemical estimations**

1. Quantitative estimation of amino nitrogen by Sorensen's formol titration method (percentage as well as total quantity to be done). Expression of results in terms of amino nitrogen, ammonia, and glycine.
2. Quantitative estimation of glucose by Benedict's Quantitative Method (percentage as well as total quantity to be done).
3. Paper Chromatography.

DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER

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

Course – XIII: Theory, Paper Code: PHY-CC43-TH-P13 [Credit: 03; Marks: 75]**[Foundations of Endocrine and Reproductive Physiology, Nutrition and Dietetics, Basic Bacteriology, Basic Immunology]****Unit – I: Foundations of Endocrine and Reproductive Physiology [15 Marks]**

Hormones: Classification and general mechanism of hormone action. Hypothalamus: Basic concept of neurohormone. Pituitary: Anterior and Posterior Pituitary- Histological Structure, hormones and functions. Hypo and Hyperactive state of Pituitary. Regulation of secretion-feedback regulation.

Anatomical positions of Reproductive organs Primary and accessory sex organs and secondary sex characters. Testis: Histology of Testis. Spermatogenesis and endocrine functions. Ovary: Histology of Ovary, Oogenesis, Ovarian hormones and their functions Menstrual cycle and its hormonal control. Pregnancy: role of hormones. Development of Mammary Gland, lactation: role of hormones.

Unit–II: Nutrition and dietetics – I [15 Marks]

Vitamins: Thiamin, Riboflavin, Niacin, Pyridoxine, Pantothenic Acid, Biotin, Cyanocobalamin, Folic Acid, Ascorbic Acid, Inositol. Vitamins A, D, E and K. Dietary sources, daily requirements, physiological functions, deficiency symptoms, hypervitaminosis, antivitaminosis. Minerals: Sources, physiological functions of sodium, potassium, calcium, phosphorus, iron, zinc, iodine and fluoride.

Unit –I II: Nutrition and dietetics – II [15 Marks]

BMR, RQ, SDA: Definition, Factors affecting. Determination and physiological significance. Fuel Values of Food. Body calorie requirements – adult consumption unit. Dietary requirements of carbohydrate, protein, lipid and other nutrients. Balanced diet and principles of formulation of balanced diets for adult man, adult woman, lactating woman and pregnant women. Nitrogen balance. Protein Sparing. Supplementary value of proteins. Biological value of proteins. Net protein utilization. Protein efficiency ratio. Dietary fibers.

Unit–IV: Basic Bacteriology [15 Marks]

Bacterial classification based on staining techniques (Gram stain and Acid-fast stain) and morphological aspect. Bacterial structure: cell-wall, LPS layer, pili, flagella, chromosome, plasmid, spores and cysts. Culture of bacteria: Nutritional requirement – complex and synthetic media, preparation of media; physical factors required for growth (temperature, pH and gaseous requirement); bacterial growth curve: different phases and their significance, continuous growth culture and its utility.

Unit-V: Basic Immunology [15 Marks]

Elementary knowledge of innate and acquired immunity. Humoral and cell mediated immunity
Cells and organs involved in immune response. Immunogens and antigens: Requirements of immunogenicity, epitopes recognized by B- & T- cells, haptens, adjuvants, cross-reactivity. Antibody structure, classification and functions: Primary & secondary. Antigen - antibody interactions - Primary interaction: association constant, affinity & avidity. Secondary interaction: precipitation & agglutination. Brief idea of autoimmunity, cancer immunotherapy and AIDS. Vaccination: Passive and active immunization, types and uses of vaccine. Toxins and toxoids. Hybridoma technology.

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 – XIV: Practical, Paper Code: PHY-CC43-PR- P14 [Credit: 01; Marks: 25]

1. Hand Written Diet Survey Report of a Community/Family as per ICMR Specification.
2. Quantitative estimation of lactose in milk and sucrose in aqueous solution by Benedict's Quantitative Method (percentage quantity to be done).
3. Gram Staining
4. Double immunodiffusion (Ouchterlony method)
5. Study of haem agglutination

Demonstrations:

Bacterial Culture Fundamentals: Culture media preparation, Aseptic technique, Pour plate method, Streaking and subculturing of bacteria, Culture contamination detection.

DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER

[Experiment: 10, Report: 05, Viva-Voce: 05, Laboratory Note Book: 05]

**Course – XV: Theory, Paper Code: PHY-CC44-TH-P15 [Credit: 03; Marks: 75]
[Chronobiology & Stress Physiology, Aviation & Space Physiology, Stem cell Biology,
Biostatistics, Computer and its application]**

Unit I: Chronobiology & Stress Physiology [15 Marks]

Different types of physiological rhythms – ultradian, circadian, infradian. Different zeitgebers and their relation with the circadian clock. Hormonal biorhythms and their significance: Pineal. Biological clock and Sleep-wakefulness cycle. Body temperature rhythm. Time-keeping genes. Jet lag and shift work. Stress: Physical and Emotional Stressors. General Adaptation Syndrome. Effects of chronic stress on Cardiovascular Disease, Heat disorders, and its preventive measures. Effects of hypobaric and hyperbaric environment. Heat-shock Proteins Oxidative Stress-Formation of Reactive Oxygen Species.

Unit II: Aviation and Space Physiology [15 Marks]

Study of Parameters related to space flight: Acceleration, Deceleration, Weightlessness, Thermal Extreme, High 'g', Ionizing Radiation, Meteorites. The Cabin Atmosphere in Space flights: Living and Working in Space, Physiological effects: Physiological Adaptations in space exploration and cellular basis, Pathophysiology, Rehabilitation, and Countermeasures with respect to different physiological. General Medical Emergencies, Waste removal and/or storage. Nutritional issues. Principles of space crew health monitoring and care, Space as a Biomedical Laboratory.

Unit-III: Introduction to Stem Cell Biology [15marks]

Definition, types, and characteristics of stem cells Historical perspective and milestones in stem cell research Ethical considerations and regulations in stem cell research Stem Cell Properties and Behavior: Self-renewal, potency, and differentiation, Stem cell niches and microenvironments Embryonic and Adult Stem Cells Embryonic stem cells: derivation, culture, and applications Adult stem cells: types, functions, and niches Induced pluripotent stem cells (iPSCs): generation and application Cancer stem cells: concept, characteristics, and implications .Stem cell Banking.

Unit –IV: Biostatistics – II [15 Marks]

Degrees of freedom. Probability. Normal distribution. Student's t distribution. Testing of hypothesis - Null hypothesis, errors of inference, levels of significance, t-test and z score for significance of difference. Distribution-free test - Chi-square test. Linear correlation and linear regression. One way ANOVA, non-parametric statistics.

Unit – V: Computer & its application in physiology – II [15 Marks]

Simulation & Modeling of Physiological Problems.

Application of Computer for Solving Physiological Problems- Writing, editing in MS WORD, Entering and Editing Numerical values in MS Excel and Presentation of slides in MS Power Point presenting the data. Internet Concepts and Library Searching Techniques.

Human-computer Interaction.

DISTRIBUTION OF QUESTIONS IN THEORETICAL PAPER

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

Course – XVI: Practical, Paper Code: PHY-CC45-PR-P16 [Credit: 01; Marks: 25]

- 1.A Project work on the assessment of individual differences in human circadian rhythm (chronotype in human population) by questionnaire method.
- 2.Graphical representation of data in frequency polygon and histogram. Student's t-test for significance of difference between means. Evaluation of statistical significance using One way ANOVA.
3. Statistical analysis and graphical representation of biological data with a computer application program (Microsoft Excel). Power Point presentations of relevant topics.

DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER

[Assignment: 07, Project work: 08 Viva-Voce: 05, Laboratory Note Book: 05]



UNIVERSITY OF CALCUTTA

Second Year Two Semesters (Semester - III & Semester - IV) Syllabi of Three Years B.Sc. Multidisciplinary Courses (MDC) in Studies (Under Curriculum and Credit Framework, 2022)

In

Physiology

2024

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

CORE COURSES (CC):

Course Code	Subject of the Course	Distribution of Credit		Total Credit	Marks
		TH	PR		
SEMESTER - III					
PHY-CC31-TH-P05	Theory (Blood and Body Fluids, Cardiovascular Physiology, Respiratory Physiology, Digestive System, Excretory Physiology)	03	00	03	75
PHY-CC31-PR-P06	Practical (Blood and Body Fluids, Cardiovascular Physiology, Respiratory Physiology, Digestive System, Excretory Physiology)	00	01	01	25
Total		03	01	04	100
SEMESTER - IV					
PHY-CC41-TH-P09	Theory (Applied Hematology, Cardiovascular Disorders, Diseases of GI System & Excretory System and Bioinformatics)	03	00	03	75
PHY-CC41-PR-P10	Practical (Applied Hematology, Cardiovascular Disorders, Diseases of GI System & Excretory System and Bioinformatics)	00	01	01	25
PHY-CC42-TH-P11	Theory (Reproductive Physiology, Nutrition and Dietetics, Basic Bacteriology, Basic Immunology)	03	00	03	75

PHY-CC42-PR-P12	Practical (Reproductive Physiology, Nutrition and Dietetics, Basic Bacteriology, Basic Immunology)	00	01	01	25
Total		06	02	08	200

Note: Students who will opt Physiology as Minor of Three Years B.Sc. Multidisciplinary Courses (MDC) in Studies (Under Curriculum and Credit Framework, 2022) will take CC11 (*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*) in Semester – III and CC21 (*Cell signaling, Enzymes, Biophysicochemical principles*) in Semester – IV as published in the University of Calcutta, Notification No. CSR/13/2023 dated 12/07/2023

CORE COURSES (CC)

SEMESTER - III

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

**Course – V: Theory, Paper Code: PHY-CC31-TH-P05 [Credit: 03; Marks: 75]
[Blood and Body Fluids, Cardiovascular Physiology, Respiratory Physiology, Digestive System, Excretory Physiology]**

Unit – I: Blood and Body Fluids – I [15 Marks]

Bone marrow. Formed elements of blood: origin, formation, functions and fate. Plasma proteins—normal values, origin and functions. Erythropoiesis: Process, Iron-ferritin-transferrin system, Role of folic acid and cyanocobalamin, Role of erythropoietin. Erythrocytes: Structural architecture, Hemoglobin – Structure, reactions, biosynthesis, and catabolism. Foetal Hemoglobin. Abnormal hemoglobins. Different types of anemia and their causes. Leucopoiesis. Leukocytes: Lymphocytes, mast cells, plasma cells, macrophages and their involvement in immune network; Blood volume: normal values, regulation and determination by dye and radioisotope methods.

Unit – II: Cardiovascular Physiology - I [15 Marks]

Anatomy of the heart. Properties of cardiac muscle. Origin and propagation of cardiac impulse. Cardiac cycle: Events. Pressure and volume changes. Heart sounds. Murmurs. Cardiac output: Measurement by application of Fick's principle & factors affecting. Starling's law of heart. Blood pressure: Types, Factors affecting blood pressure. Electrocardiography: The normal electrocardiogram, electrocardiographic leads, vectorial analysis, the vectorcardiogram and the mean electrical axis of heart. Principles of Echocardiography.

Unit –III: Respiratory Physiology – I [15 Marks]

Anatomy, histology and functional organization of the lungs and airways. Mechanics of breathing: Role of respiratory muscles, glottis. Compliance of lungs and chest wall, pressure-volume relationships, alveolar surface tension and surfactant, work of breathing. Spirometry: Lung volumes and capacities. Dead space. Pulmonary Circulation, Oxygen transport, Carbon-dioxide transport, Ventilation-perfusion ratio.

Unit – IV: Digestive system – I [15 Marks]

Anatomy, histology and functional organization of alimentary canal. Digestive glands – histological structures of salivary glands, pancreas, liver. Deglutition. Movements of alimentary canal and their regulations. Composition, functions and regulation of the secretion of salivary, gastric, pancreatic and intestinal juices and bile. Enterohepatic circulation. Carbohydrate, lipid, protein digestion and absorption, GALT.

Unit- V: Excretory Physiology – I [15 Marks]

Kidney: Anatomy and functional organization of kidney. Histology of nephron. Renal circulation – peculiarities and autoregulation. Formation of urine – glomerular function and tubular functions. Countercurrent multiplier and exchanger. Renal regulation of osmolarity and volume of blood fluids. Diabetes insipidus. Formation of hypertonic urine. Renal regulation of acid-base balance, acidification of urine. Structure and functions of skin. Sweat glands. Insensible and sensible perspiration. Regulation of body temperature -- physical and physiological processes involved in it. Physiology of sweat secretion and its regulation. Pyrexia, hyperthermia and hypothermia.

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 – VI: Practical, Paper Code: PHY-CC31-PR-P06 [Credit: 01; Marks: 25]

1. **Haematological experiments:** Preparation and staining of blood film with Leishman's stain. Identification of blood cells. Total count of W.B.C. and R.B.C. Differential count of W.B.C. Hemoglobin estimation by Drabkin's Method. Preparation of hemin crystals.
2. **Postural Effects on Blood Pressure:** Effects of sitting, lying, and standing postures on arterial blood pressure.

2. Respiratory Revelations: Pneumographic recording of effects of hyperventilation, breath-holding and talking. Lung function tests using Spirometry (Digital) and analysis of the results.

4.E.C.G: Recording and analysis of the normal tracing.

Demonstration: Palpation of arterial pulse from Radial, Brachial, Popliteal, Dorsalis pedis and determination of pulse count.

DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER

[Experiment: 15, Viva-Voce: 05, Laboratory Notebook: 05]

SEMESTER - IV

Total credit – 08 (Theory-06, Practical-02) Total marks: 200

Course – VII: Theory, Paper Code: PHY-CC41-TH-P07 [Credit: 03; Marks: 75]

[Applied Hematology, Cardiovascular Disorders, Diseases of GI System & Excretory System and Bioinformatics]

Unit-I: Applied Hematology, Blood & Body fluids - II [15 Marks]

Hemostasis – factors, mechanism, anticoagulants, procoagulants, Fibrinolysis, Pathogenesis of Thrombosis & Thrombolytic agents. Disorders of hemostasis-hemophilia, Thrombosis and Embolism. Definition, determination, and significance of TC, DC, ESR, Arneth count, PCV, MCV, MHC, MCHC, bleeding time, clotting time, and prothrombin time. Blood group: ABO and Rh systems (Chemical nature of relevant biomolecules). Erythroblastosis Fetalis. Blood transfusion and its hazards. Lymph and tissue fluids: Formation, circulation, functions and fate. Lymphatic organs: Histological structures and functions of lymph gland and spleen. Splenomegaly: causes and effects. Circulatory disorder: Oedema, Varicose vein.

Unit II: Cardiovascular Disorders [15Marks].

Cardiac Arrhythmias. Myocardial Infarctions. Coronary Circulation. Myocardial necrosis and Myocarditis: Cardiac Hypertrophy, Heart failure and ischemic heart disease. Coronary bypass, coronary angioplasty. Cytotoxic necrosis. Cardiotoxins – important cardiotoxic substances.

Unit –III: Common Diseases of Gastrointestinal & Excretory System [15Marks]

Basic concepts of irritable bowel syndrome (IBS). Gastroesophageal Reflux Disease (GERD). Peptic Ulcer, Jaundice, and Gallstones. ulcerative colitis, appendicitis gastritis, Renal function tests – creatinine, inulin, urea, and PAH clearance tests. Constituents of urine. Abnormal constituents of urine, and pathophysiological significance. Renal dialysis. Non-excretory functions of the kidney. Urinary Tract Infections (UTIs).

Unit--IV: Basic Genetics [15 Marks]

Chromosome: structure and function, Mitosis and meiosis, Crossing over and recombination, Chromosomal Mutations. Chromosomal DNA packaging-nucleosomes and a higher level of organization of chromatin. Euchromatin and heterochromatin. Human genome and its characteristics. Mitochondrial DNA. Epistasis, Penetrance, Expressivity, Pleiotropism. Karyotyping. Molecular Genetics: DNA structure and replication, Gene expression and regulation, Mutation and repair, Gene cloning and sequencing.

Unit-V: Bioinformatics [15 Marks]

Introduction to Bioinformatics, Literature databases (PubMed), Primary nucleotide sequence databases (NCBI, EMBL, DDBJ), Secondary nucleotide sequence databases (UniGene, SGD etc.), Protein sequence databases (SwissProt/ TrEMBL, PIR), Sequence motif databases (Pfam, PROSITE), Structure databases (PDB, NSD, SCOP, CATH), Gene Expression databases. Introduction to computational biology- prediction of 3-D protein structure, identification of unknown protein, drug design, and application in medical sciences.

DISTRIBUTION OF QUESTIONS IN THEORETICAL PAPER

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

Course – VIII: Practical, Paper Code: PHY-CC41-PR- P08 [Credit: 01; Marks: 25]

1. Determination of blood group, bleeding time and clotting time.
2. Qualitative tests to identify Normal & Abnormal constituents of urine:
Normal constitution: Chloride, Sulphate, Phosphate, Creatinine and Urea;
Abnormal constituents of urine: Glucose, Protein, Acetone, Bile pigment and Bile Salt.
3. Retrieval of a particular gene sequence of interest from GenBank.

DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER

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

Course – IX: Theory, Paper Code: PHY-CC43-TH-P09 [Credit: 03; Marks: 75]**[Reproductive Physiology, Nutrition and Dietetics, Basic Bacteriology, Basic Immunology]****Unit – I: Reproductive Physiology [15 Marks]**

Anatomical positions of Reproductive organs Primary and accessory sex organs and secondary sex characters. Testis: Histology of Testis. Spermatogenesis and endocrine functions. Ovary: Histology of Ovary, Oogenesis, Ovarian hormones and their functions Menstrual cycle and its hormonal control. Pregnancy: role of hormones. Development of Mammary Gland, lactation: role of hormones.

Unit–II: Nutrition and dietetics – I [15 Marks]

Vitamins: Thiamin, Riboflavin, Niacin, Pyridoxine, Pantothenic Acid, Biotin, Cyanocobalamin, Folic Acid, Ascorbic Acid, Inositol. Vitamins A, D, E and K. Dietary sources, daily requirements, physiological functions, deficiency symptoms, hypervitaminosis, antivitamins. Minerals: Sources, physiological functions of sodium, potassium, calcium, phosphorus, iron, zinc, iodine and fluoride.

Unit –I II: Nutrition and dietetics – II [15 Marks]

BMR, RQ, SDA: Definition, Factors affecting. Determination and physiological significance. Fuel Values of Food. Body calorie requirements – adult consumption unit. Dietary requirements of carbohydrate, protein, lipid and other nutrients. Balanced diet and principles of formulation of balanced diets for adult man, adult woman, lactating woman and pregnant women. Nitrogen balance. Protein Sparing. Supplementary value of proteins. Biological value of proteins. Net protein utilization. Protein efficiency ratio. Dietary fibers.

Unit–IV: Basic Bacteriology [15 Marks]

Bacterial classification based on staining techniques (Gram stain and Acid-fast stain) and morphological aspect. Bacterial structure: spores and cysts. Culture of bacteria: Nutritional requirement – complex and synthetic media, preparation of media; physical factors required for growth (temperature, pH and gaseous requirement); bacterial growth curve: different phases.

Unit-V: Basic Immunology [15 Marks]

Elementary knowledge of innate and acquired immunity. Humoral and cell mediated immunity Cells and organs involved in immune response. Immunogens and antigens: haptens, adjuvants,. Antibody structure, classification and functions. Antigen - antibody interactions, precipitation & agglutination. Brief idea of autoimmunity, cancer immunotherapy and AIDS. Vaccination: Passive and active immunization, types and uses of vaccine. Toxins and toxoids. Hybridoma technology.

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 – X: Practical, Paper Code: PHY-CC43-PR- P10 [Credit: 01; Marks: 25]

1. Hand Written Diet Survey Report of a Community/Family as per ICMR Specification.
2. Quantitative estimation of amino nitrogen by Sorensen's formol titration method (percentage quantity to be done). Expression of results in terms of amino nitrogen.
2. Quantitative estimation of glucose by Benedict's Quantitative Method (percentage quantity to be done).
4. Gram Staining.

Demonstrations:

Bacterial Culture Fundamentals: Culture media preparation, Aseptic technique, Pour plate method, Streaking and subculturing of bacteria, Culture contamination detection.

DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER

[Experiment: 10, Report: 05, Viva-Voce: 05, Laboratory Note Book: 05]