UNIVERSITY OF CALCUTTA

Notification No. CSR/130/2024

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 05.11.2024, approved the new revised syllabus (Semester-1,3 & 4) of Physiology (4-year Honours and Honours with Research and 3-year MDC and Minor) Courses of Studies, under CCF, under this University, as laid down in the accompanying pamphlet.

The above shall take effect from the Odd Semester Examinations,2024 and onwards.

12/11/2024

SENATE HOUSE

Kolkata-700073

12.11.2024

Prof.(Dr.) Debasis Das

Registrar

UNIVERSITY OF CALCUTTA

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

Course and Curriculum

Subject: PHYSIOLOGY (PHY)

Level: Under Graduate

Name of the Programme: 4 Years 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, Contributions of Physiologists. 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.
- 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.

UNIVERSITY OF CALCUTTA

First Semester Syllabus of Four Years B.Sc. (Honours & Honours with Research) Courses in Studies (Under Curriculum and Credit Framework, 2022)

In Physiology

Revised

Course and Curriculum

Subject: PHYSIOLOGY (PHY)
Level: Under Graduate

Name of the Programme: 4 Years 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, Contributions of Physiologists. 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.
- 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
	Semester - I	**TH**	**PR**		
PHY-CC11-TH-P01	**Theory (**History of physiology and contribution of scientists in the field of physiology, Brief overview of physiological systems, cellular basis of physiology, cellular transport, chemistry of biomolecules**)**.	**03**	**00**	**03**	**75**
PHY-CC11-PR-P02	**Practical (**History of physiology and contribution of scientists in the field of physiology, brief overview of physiological systems, cellular basis of physiology, cellular transport, chemistry of biomolecules**)**	**00**	**01**	**01**	**25**
	Total	**03**	**01**	**04**	**100**

Interdisciplinary Courses (IDC)					
Course Code	**Subject of the Course**	**Distribution of Credit**		**Total Credit**	**Marks**
	Semester – I/II/III	**TH**	**PR**		
HPY-IDC11-TH-P01	**Theory (**Cells, tissues, systems and organs of human body, Biophysical and biomolecular phenomena, regulation and coordination of internal system, applied physiology, common diseases and pathophysiological significance).	**02**	**00**	**02**	**50**
HPY-IDC11-PR-P02	**Practical (**Cells, tissues, systems and organs of human body, Biophysical and biomolecular phenomena, regulation and coordination of internal system, applied physiology, common diseases and pathophysiological significance**)**.	**00**	**01**	**01**	**25**
	Total	**02**	**01**	**03**	**75**

Skill Enhancement Courses (SEC)					
Course Code	**Subject of the Course**	**Distribution of Credit**		**Total Credit**	**Marks**
		TH	**PR**		
	Semester - I				
PHY-SEC11-TH-P01	**Theory (**Clinical Importance of Biomolecules, Methods of cell study: Microscopy, Common analytical techniques: Chromatography and centrifugation, Work and Exercise Physiology**)**.	**02**	**00**	**02**	**50**
PHY-SEC11-PR-P02	**Practical (**Clinical Importance of Biomolecules, Methods of cell study: Microscopy, Common analytical techniques: Chromatography and centrifugation, Work and Exercise Physiology**)**.	**00**	**02**	**02**	**50**
	Total	**02**	**02**	**04**	**100**

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 contribution of Scientists in the field of Physiology, Cellular Basis of Physiology, Cellular transport, Chemistry of Biomolecules)*** **and CC21 (*Cell signaling, Enzymes, Biophysiochemical 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 contribution of Scientists in the field of Physiology, Cellular Basis of Physiology,Cellular transport, Chemistry of Biomolecules)*** **and CC21 (*Cell signaling, Enzymes, Biophysiochemical 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.**

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

REVISED

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
	SEMESTER - III	**TH**	**PR**		
PHY-CC31-TH-P05	**Theory** (Blood and Body Fluids, Cardiovascular Physiology, Respiratory Physiology, Digestive System, Basic Genetics)	**03**	**00**	**03**	**75**
PHY-CC31-PR-P06	**Practical** (Blood and Body, Fluids,Cardiovascular Physiology, Respiratory, Physiology, Digestive System, BasicGenetics)	**00**	**01**	**01**	**25**
PHY-CC32-TH-P07	**Theory** (Nerve Muscle Physiology,Nervous System, Special Senses, Biostatistics**)**	**03**	**00**	**03**	**75**
PHY-CC32-PR-P08	**Practical** (Nerve Muscle Physiology, Nervous System,Special Senses, Biostatistics)	**00**	**01**	**01**	**25**
	Total	**06**	**02**	**08**	**200**

Skill Enhancement Courses (SEC)					
PHY-SEC31-TH-P03	**Theory** (Applied Physiology and BasicTechniques**)**	**02**	**00**	**02**	**50**
PHY-SEC31-PR-P04	**Practical** (Applied Physiology and Basic Techniques)	**00**	**02**	**02**	**50**
	Total	**02**	**02**	**04**	**100**

Course Code	Subject of the Course	Distribution of Credit	Total Credit	Marks	
	SEMESTER-IV	**TH**	**PR**		
PHY-CC41-TH-P09	**Theory** (Applied Hematology, Cardiovascular Disorders, Excretory Physiology, Common Diseases of Gl System and Excretory System and Bioinformatics)	**03**	**00**	**03**	**75**
PHY-CC41-PR-P10	**Practical (**Applied Hematology, Cardiovascular Disorders, Excretory Physiology, Common Diseases of Gl System and Excretory System and Bioinformatics)	**00**	**01**	**01**	**25**
PHY-CC42-TH-P11	**Theory** (Bioenergetics, Metabolism andCommon Metabolic Disorders)	**03**	**00**	**03**	**75**
PHY-CC42-PR-P12	**Practical** (Bioenergetics, Metabolismand Common Metabolic Disorders)	**00**	**01**	**01**	**25**
PHY-CC43-TH-P13	**Theory** (Foundations of Endocrine andReproductive Physiology, Nutrition and Dietetics, Basic Bacteriology, BasicImmunology)	**03**	**00**	**03**	**75**
PHY-CC43-PR-P14	**Practical** (Foundations of Endocrineand Reproductive Physiology, Nutrition and Dietetics, Basic Bacteriology, BasicImmunology)	**00**	**01**	**01**	**25**
PHY-CC44-TH-P15	**Theory** (Chronobiology and Stress Physiology, Aviation and Space Physiology, Stem cell Biology, Biostatistics, Computer and itsapplication)	**03**	**00**	**03**	**75**
PHY-CC44-PR-P16	**Practical (**Chronobiology and Stress Physiology, Aviation and Space Physiology, Stem cell Biology, Biostatistics, Computer and itsapplication)	**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 contribution of Scientists in the field of Physiology, Cellular Basis of Physiology, Cellular transport, Chemistry of Biomolecules)* and CC21 (*Cell signaling, Enzymes, Biophysiochemical 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 contribution of Scientists in the field of Physiology, Cellular Basis of Physiology,Cellular transport, Chemistry of Biomolecules)* and CC21 (*Cell signaling, Enzymes, Biophysiochemical 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.

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
	Semester - I	**TH**	**PR**		
PHY-CC11-TH-P01	**Theory (**History of physiology and contribution of scientists in the field of physiology, Brief overview of physiological systems, cellular basis of physiology, cellular transport, chemistry of biomolecules**)**.	**03**	**00**	**03**	**75**
PHY-CC11-PR-P02	**Practical (**History of physiology and contribution of scientists in the field of physiology, brief overview of physiological systems, cellular basis of physiology, cellular transport, chemistry of biomolecules**)**	**00**	**01**	**01**	**25**
	Total	**03**	**01**	**04**	**100**

Interdisciplinary Courses (IDC)					
Course Code	**Subject of the Course**	**Distribution of Credit**		**Total Credit**	**Marks**
	Semester – I/II/III	**TH**	**PR**		
HPY-IDC11-TH-P01	**Theory (**Cells, tissues, systems and organs of human body, Biophysical and biomolecular phenomena, regulation and coordination of internal system, applied physiology, common diseases and pathophysiological significance).	**02**	**00**	**02**	**50**
HPY-IDC11-PR-P02	**Practical (**Cells, tissues, systems and organs of human body, Biophysical and biomolecular phenomena, regulation and coordination of internal system, applied physiology, common diseases and pathophysiological significance**)**.	**00**	**01**	**01**	**25**
	Total	**02**	**01**	**03**	**75**

Skill Enhancement Courses (SEC)					
Course Code	**Subject of the Course**	**Distribution of Credit**		**Total Credit**	**Marks**
		TH	**PR**		
	Semester - I				
PHY-SEC11-TH-P01	**Theory (**Clinical Importance of Biomolecules, Methods of cell study: Microscopy, Common analytical techniques: Chromatography and centrifugation, Work and Exercise Physiology**)**.	**02**	**00**	**02**	**50**
PHY-SEC11-PR-P02	**Practical (**Clinical Importance of Biomolecules, Methods of cell study: Microscopy, Common analytical techniques: Chromatography and centrifugation, Work and Exercise Physiology**)**.	**00**	**02**	**02**	**50**
	Total	**02**	**02**	**04**	**100**

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 contribution of scientists in the field of physiology and brief overview of physiological systems, Cellular Basis of Physiology, Cellular transport, Chemistry of Biomolecules]

Unit - I: History of Physiology and contribution of scientists in the field of physiology and brief overview of physiological systems [15 Marks]

History of Physiology and contribution of a few scientists in the field of Physiology: William Harvey, Claude Bernard, Ivan Pavlov, Sir Charles S. Sherrington, Subodh Chandra Mahalanobis, N. M. Basu, Sacchidananda Banerjee, Autar Singh Paintal.
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, systemic nomenclature and structure. Mono-, Di- and Triglycerides. Properties of Fat and Fatty acids Hydrolysis, saponification number, Iodine number, Acetyl number, Acid number, Reichert-Meissl number. Cis-trans isomerism. Eicosanoids, Phospholipids, Glycolipids, Sphingolipids, Steroids and sterols, Cholesterol & its ester -their structure and physiological importance. Lipoproteins - Structure and classification. Micelle, bilayer, Liposome.

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

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 (α-helix and β-pleated sheet), Tertiary and Quarternary. Forces stabilizing the structures. Denaturation and Renaturation.

Purine and Pyrimidine bases: Structure, nomenclature and tautomerism.

Nucleic acids: Nucleosides and Nucleotides-structure. Polynucleotides. DNA double helix, Primary, Secondary and Tertiary structure. A-DNA, B-DNA and Z-DNA. RNA - Structure, types, features. Denaturation and annealing of DNA. Hyperchromicity, melting temperature and half Cot value.

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

INTERDISCIPLINARY COURSE (IDC)
Total Credit: 3 [Theory: 2, Practical: 1], Full Marks: 75
Course: Theory, Paper Code: PHY-IDC-TH-P01 [Credit: 02; Marks: 50]

Unit-I: Cells, Tissues, Systems, Organs of Human Body [10 Marks]
Cells in relation to human physiological functions, Cell organelles and their functions. Physiological system as a cluster of cells and tissues. Location and basic functions of major body-organs: Heart, Lung, Brain, Spinal cord, Liver, Stomach, Pancreas, Kidney, Digestive tract, Intestines, Sense organs, Reproductive organs.

Unit-II: Biophysical and Biomolecular Phenomena [10 Marks]
Importance of major biophysical parameters in Physiology: Diffusion, Osmosis, Absorption, Adsorption, pH, Buffer. Macro and Micronutrients and biomolecules involved in maintenance of human health: Definition with primary classifications, examples and functions of Carbohydrate, Protein, Lipids, Vitamins. Enzymes: Classification, factors affecting enzyme action. Concept of coenzymes, prosthetic groups, mettaloenzymes, isozymes, basic concepts on allosteric enzymes.

Unit-III: Regulation and coordination of internal system [10 Marks]
Composition and functions of blood; functions of different blood cells. Composition and functions of Plasma proteins, hemoglobin molecule and anaemia. Exchange of respiratory gasses between lung and blood, and blood and tissue and their functions. Definition of hormone. Major secreting hormones and their important functions: Pituitary, Adrenal, Thyroid and Pancreas. Primary concept on Nerve fibers, Synapses, reflex action. Functional difference between central nervous system and peripheral nervous system.

Unit-IV: Applied Physiology [10 Marks]
Hematology: Definition, ABO and Rh Blood group system. Precautions of blood transfusion, Concept of Blood Bank. Microbiology and Immunology: Types of microbes, Beneficial and harmful bacteria with examples. Definition of Antigen and Antibody and Antibiotic and Vaccine with examples. Biotechnology: Outline concept and its modern applications. Basic concepts of Ergonomics and its importance in occupational health. Sports and Exercise Physiology: Physical fitness. Classification of sports, Basic concept of anthropometry. Application of statistics in biological science, Basic concept of population biology and Sample.

Unit-V: Common Diseases and Patho-physiological significance [10 Marks]:
Prevailing global communicable and non-communicable diseases, their primary

causes and suggested measures: Influenza, Tuberculosis, COVID-19, Diabetes mellitus, Haemophilia, Thalassaemia, Stroke, Hypothyroidism, Obesity. Pathophysiological tests, their normal range in the system and indicative diseases: TC, DC, ESR, Arneth Count, Fasting and Post-prandial blood sugar tests, Glycosylated haemoglobin, Bilirubin, Urea, Uric acid, Creatinine, SGOT, SGPT, Alkaline Phosphatase, Acid Phosphatase.

DISTRIBUTION OF QUESTIONS IN PRACTICAL 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. **attempt all the five** questions

Course: Practical; Paper Code: PHY-IDC-PR-P01
[Credit: 01; Marks: 25]

1. Determination of Heart rate and Respiratory Rate.
2. Measurement of systolic and diastolic arterial blood pressure by sphygmomanometer and determination of pulse pressure and mean pressure.
3. Determination of Body Mass Index and Body Surface Area by using nomogram.

Demonstration:
Identification of stained sections of different mammalian tissues and organs: Liver, Kidney, Lung, Stomach, Small Intestine, Large Intestine, Pancreas, Thyroid gland, Adrenal gland, Ovary, Testis, Skin, Skeletal muscle, Cardiac muscle, Smooth muscle, Cerebellum, Ovary, Testis,

DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER

[Experiment: 15, Viva-Voce: 05, Laboratory Notebook: 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, Methods of cell study: Microscopy, Common analytical techniques: Chromatography and centrifugation, Work and Exercise Physiology]

Unit – I: Clinical importance of biomolecules [10 Marks]
Carbohydrates: Estimation of glucose, glycosurias, OGTT, hyper & hypoglycemia, Lipids: lipid profile estimation, hypercholesterolemia, hyperlipoproteinemia, atherosclerosis. Proteins: albumin, hypoalbuminemia, hypoproteinemia, Bence Jones proteins.

Unit – II: Methods of cell study: Microscopy [10 Marks]
Principles of construction and uses of compound microscope, phase contrast microscope, polarizing microscope, confocal microscope, transmission and scanning electron microscope and photoelectric colorimeter.

Unit – III: Common analytical techniques: Chromatography and centrifugation [10 Marks]
Principles and uses of paper chromatography, thin layer chromatography, affinity chromatography, ion exchange chromatography. Electrophoresis: principles and method, uses of agarose gel electrophoresis, SDS-PAGE, Principles of centrifugation, ultracentrifugation: moving boundary and density-gradient ultracentrifugation.

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. 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.

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 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 H2SO4 solution, N/100 KMnO4 Solution, N/100 Sodium Oxalate Solution. Standardization of N/10 NaOH, N/10 HCl, N/10 H2SO4 solution against standard N/10 Oxalic acid 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]

UNIVERSITY OF CALCUTTA

First Semester Syllabus of Three Years B.Sc.
(Multidisciplinary Courses in Studies under Curriculum and Credit Framework, 2022)
In Physiology

Revised

Course and Curriculum
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, Contributions by Physiologists. 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
	Semester - I	**TH**	**PR**		
PHY-CC11-TH-P01	**Theory (**History of physiology and contribution of scientists in the field of physiology, Brief overview of physiological systems, cellular basis of physiology, cellular transport, chemistry of biomolecules**).**	**03**	**00**	**03**	**75**
PHY-CC11-PR-P02	**Practical (**History of physiology and contribution of scientists in the field of physiology, brief overview of physiological systems, cellular basis of physiology, cellular transport, chemistry of biomolecules**)**	**00**	**01**	**01**	**25**
	Total	**03**	**01**	**04**	**100**

Interdisciplinary Courses (IDC)

Course Code	Subject of the Course	Distribution of Credit		Total Credit	Marks
	Semester – I/II/III	**TH**	**PR**		
HPY-IDC11-TH-P01	**Theory (**Cells, tissues, systems and organs of human body, Biophysical and biomolecular phenomena, regulation and coordination of internal system, applied physiology, common diseases and pathophysiological significance).	**02**	**00**	**02**	**50**
HPY-IDC11-PR-P02	**Practical (**Cells, tissues, systems and organs of human body, Biophysical and biomolecular phenomena, regulation and coordination of internal system, applied physiology, common diseases and pathophysiological significance**).**	**00**	**01**	**01**	**25**
	Total	**02**	**01**	**03**	**75**

Skill Enhancement Courses (SEC)					
Course Code	**Subject of the Course**	**Distribution of Credit**		**Total Credit**	**Marks**
		TH	**PR**		
	Semester – I/II/III				
PHY-SEC11-TH-P01	**Theory (**Clinical Importance of Biomolecules, Methods of cell study: Microscopy, Common analytical techniques: Chromatography and centrifugation, Work and Exercise Physiology**).**	**02**	**00**	**02**	**50**
PHY-SEC11-PR-P02	**Practical (**Clinical Importance of Biomolecules, Methods of cell study: Microscopy, Common analytical techniques: Chromatography and centrifugation, Work and Exercise Physiology**).**	**00**	**02**	**02**	**50**
	Total	**02**	**02**	**04**	**100**

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 contribution of scientists in the field of physiology and brief overview of physiological systems, Cellular Basis of Physiology, Cellular transport, Chemistry of Biomolecules]

Unit - I: History of Physiology and contribution of scientists in the field of physiology and brief overview of physiological systems [15 Marks]

History of Physiology and contribution of a few scientists in the field of Physiology: William Harvey, Claude Bernard, Ivan Pavlov, Sir Charles S. Sherrington, Subodh Chandra Mahalanobis, N. M. Basu, Sacchidananda Banerjee, Autar Singh Paintal.
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, systemic nomenclature and structure. Mono-, Di- and Triglycerides. Properties of Fat and Fatty acids Hydrolysis, saponification number, Iodine number, Acetyl number, Acid number, Reichert-Meissl number. Cis-trans isomerism. Eicosanoids, Phospholipids, Glycolipids, Sphingolipids, Steroids and sterols, Cholesterol & its ester -their structure and physiological importance. Lipoproteins - Structure and classification. Micelle, bilayer, Liposome.

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

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 (α-helix and β-pleated sheet), Tertiary and Quarternary. Forces stabilizing the structures. Denaturation and Renaturation.

Purine and Pyrimidine bases: Structure, nomenclature and tautomerism.

Nucleic acids: Nucleosides and Nucleotides-structure. Polynucleotides. DNA double helix, Primary, Secondary and Tertiary structure. A-DNA, B-DNA and Z-DNA. RNA - Structure, types, features. Denaturation and annealing of DNA. Hyperchromicity, melting temperature and half Cot value.

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

INTERDISCIPLINARY COURSE (IDC)
Total Credit: 3 [Theory: 2, Practical: 1], Full Marks: 75
Course: Theory, Paper Code: PHY-IDC-TH-P01 [Credit: 02; Marks: 50]

Unit-I: Cells, Tissues, Systems, Organs of Human Body [10 Marks]
Cells in relation to human physiological functions, Cell organelles and their functions. Physiological system as a cluster of cells and tissues. Location and basic functions of major body-organs: Heart, Lung, Brain, Spinal cord, Liver, Stomach, Pancreas, Kidney, Digestive tract, Intestines, Sense organs, Reproductive organs.

Unit-II: Biophysical and Biomolecular Phenomena [10 Marks]
Importance of major biophysical parameters in Physiology: Diffusion, Osmosis, Absorption, Adsorption, pH, Buffer. Macro and Micronutrients and biomolecules involved in maintenance of human health: Definition with primary classifications, examples and functions of Carbohydrate, Protein, Lipids, Vitamins. Enzymes: Classification, factors affecting enzyme action. Concept of coenzymes, prosthetic groups, mettaloenzymes, isozymes, basic concepts on allosteric enzymes.

Unit-III: Regulation and coordination of internal system [10 Marks]
Composition and functions of blood; functions of different blood cells. Composition and functions of Plasma proteins, hemoglobin molecule and anaemia. Exchange of respiratory gasses between lung and blood, and blood and tissue and their functions. Definition of hormone. Major secreting hormones and their important functions: Pituitary, Adrenal, Thyroid and Pancreas. Primary concept on Nerve fibers, Synapses, reflex action. Functional difference between central nervous system and peripheral nervous system.

Unit-IV: Applied Physiology [10 Marks]
Hematology: Definition, ABO and Rh Blood group system. Precautions of blood transfusion, Concept of Blood Bank. Microbiology and Immunology: Types of microbes, Beneficial and harmful bacteria with examples. Definition of Antigen and Antibody and Antibiotic and Vaccine with examples. Biotechnology: Outline concept and its modern applications. Basic concepts of Ergonomics and its importance in occupational health. Sports and Exercise Physiology: Physical fitness. Classification of sports, Basic concept of anthropometry. Application of statistics in biological science, Basic concept of population biology and Sample.

Unit-V: Common Diseases and Patho-physiological significance [10 Marks]:
Prevailing global communicable and non-communicable diseases, their primary

causes and suggested measures: Influenza, Tuberculosis, COVID-19, Diabetes mellitus, Haemophilia, Thalassaemia, Stroke, Hypothyroidism, Obesity. Pathophysiological tests, their normal range in the system and indicative diseases: TC, DC, ESR, Arneth Count, Fasting and Post-prandial blood sugar tests, Glycosylated haemoglobin, Bilirubin, Urea, Uric acid, Creatinine, SGOT, SGPT, Alkaline Phosphatase, Acid Phosphatase.

DISTRIBUTION OF QUESTIONS IN PRACTICAL 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. **attempt all the five** questions

Course: Practical; Paper Code: PHY-IDC-PR-P01
[Credit: 01; Marks: 25]

1. Determination of Heart rate and Respiratory Rate.
2. Measurement of systolic and diastolic arterial blood pressure by sphygmomanometer and determination of pulse pressure and mean pressure.
3. Determination of Body Mass Index and Body Surface Area by using nomogram.

Demonstration:
Identification of stained sections of different mammalian tissues and organs: Liver, Kidney, Lung, Stomach, Small Intestine, Large Intestine, Pancreas, Thyroid gland, Adrenal gland, Ovary, Testis, Skin, Skeletal muscle, Cardiac muscle, Smooth muscle, Cerebellum, Ovary, Testis,

DISTRIBUTION OF QUESTIONS IN PRACTICAL PAPER

[Experiment: 15, Viva-Voce: 05, Laboratory Notebook: 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, Methods of cell study: Microscopy, Common analytical techniques: Chromatography and centrifugation, Work and Exercise Physiology]

Unit – I: Clinical importance of biomolecules [10 Marks]
Carbohydrates: Estimation of glucose, glycosurias, OGTT, hyper & hypoglycemia, Lipids: lipid profile estimation, hypercholesterolemia, hyperlipoproteinemia, atherosclerosis. Proteins: albumin, hypoalbuminemia, hypoproteinemia, Bence Jones proteins.

Unit – II: Methods of cell study: Microscopy [10 Marks]
Principles of construction and uses of compound microscope, phase contrast microscope, polarizing microscope, confocal microscope, transmission and scanning electron microscope and photoelectric colorimeter.

Unit – III: Common analytical techniques: Chromatography and centrifugation [10 Marks]
Principles and uses of paper chromatography, thin layer chromatography, affinity chromatography, ion exchange chromatography. Electrophoresis: principles and method, uses of agarose gel electrophoresis, SDS-PAGE, Principles of centrifugation, ultracentrifugation: moving boundary and density-gradient ultracentrifugation.

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. 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.

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 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 H2SO4 solution, N/100 KMnO4 Solution, N/100 Sodium Oxalate Solution. Standardization of N/10 NaOH, N/10 HCl, N/10 H2SO4 solution against standard N/10 Oxalic acid 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]

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 contribution of Scientists in the field of Physiology, Cellular Basis of Physiology, Cellular transport, Chemistry of Biomolecules)* and CC21 (*Cell signaling, Enzymes, Biophysiochemical 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 contribution of Scientists in the field of Physiology, Cellular Basis of Physiology,Cellular transport, Chemistry of Biomolecules)* and CC21 (*Cell signaling, Enzymes, Biophysiochemical 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.

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; BenjaminCummings.
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. 4th 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. Essentials of Biostatistics and Research Methodology by Indranil Saha and Bobby Paul, 4th edition Academic Publishers.

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

REVISED

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
	SEMESTER - III	**TH**	**PR**		
PHY-CC31-TH-P05	**Theory** (Blood and Body Fluids, Cardiovascular Physiology, Respiratory Physiology, Digestive System, Basic Genetics)	**03**	**00**	**03**	**75**
PHY-CC31-PR-P06	**Practical** (Blood and Body, Fluids,Cardiovascular Physiology, Respiratory, Physiology, Digestive System, BasicGenetics)	**00**	**01**	**01**	**25**
PHY-CC32-TH-P07	**Theory** (Nerve Muscle Physiology,Nervous System, Special Senses, Biostatistics**)**	**03**	**00**	**03**	**75**
PHY-CC33-PR-P08	**Practical** (Nerve Muscle Physiology, Nervous System,Special Senses, Biostatistics)	**00**	**01**	**01**	**25**
	Total	**06**	**02**	**08**	**200**

Skill Enhancement Courses (SEC)					
PHY-SEC31-TH-P03	**Theory** (Applied Physiology and BasicTechniques**)**	**02**	**00**	**02**	**50**
PHY-SEC31-PR-P04	**Practical** (Applied Physiology and Basic Techniques)	**00**	**02**	**02**	**50**
	Total	**02**	**02**	**04**	**100**

Course Code	Subject of the Course	Distribution of Credit	Total Credit	Marks	
	SEMESTER-IV	**TH**	**PR**		
PHY-CC41-TH-P09	**Theory** (Applied Hematology, Cardiovascular Disorders, Excretory Physiology, Common Diseases of Gl System and Excretory System and Bioinformatics)	**03**	**00**	**03**	**75**
PHY-CC41-PR-P10	**Practical (**Applied Hematology, Cardiovascular Disorders, Excretory Physiology, Common Diseases of Gl System and Excretory System and Bioinformatics)	**00**	**01**	**01**	**25**
PHY-CC42-TH-P11	**Theory** (Bioenergetics, Metabolism andCommon Metabolic Disorders)	**03**	**00**	**03**	**75**
PHY-CC42-PR-P12	**Practical** (Bioenergetics, Metabolismand Common Metabolic Disorders)	**00**	**01**	**01**	**25**
PHY-CC43-TH-P13	**Theory** (Foundations of Endocrine andReproductive Physiology, Nutrition and Dietetics, Basic Bacteriology, BasicImmunology)	**03**	**00**	**03**	**75**
PHY-CC43-PR-P14	**Practical** (Foundations of Endocrineand Reproductive Physiology, Nutrition and Dietetics, Basic Bacteriology, BasicImmunology)	**00**	**01**	**01**	**25**
PHY-CC44-TH-P15	**Theory** (Chronobiology and Stress Physiology, Aviation and Space Physiology, Stem cell Biology, Biostatistics, Computer and itsapplication)	**03**	**00**	**03**	**75**
PHY-CC44-PR-P16	**Practical (**Chronobiology and Stress Physiology, Aviation and Space Physiology, Stem cell Biology, Biostatistics, Computer and itsapplication)	**00**	**01**	**01**	**25**
	Total	**12**	**04**	**16**	**400**

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, Basic Genetics]

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

Elementary knowledge of structure and function of bone marrow in humans. Formed elements of blood: Erythrocytes, Leukocytes and Platelets; their origin, morphology, formation, functions and fate. Erythropoiesis; Mechanism, Iron-ferritin-transferrin system, Role of folic acid and cyanocobalamin, Role of erythropoietin in the regulation of erythropoiesis. Hemoglobin – structure, hemoglobin biosynthesis and its degradation, compounds and derivatives of hemoglobin. Functional aspect of Foetal Hemoglobin. Abnormal Hemoglobin. Anaemia: Definition, different types of anemia and their causes, remedial measures. Concept of plasma and plasma proteins–origin, types, functions and normal levels in healthy individuals. Concept of blood volume, its normal values in humans. Regulation of blood volume. Determination of blood volume by dye dilution 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 including murmurs. Pulse- arterial and venous, Cardiac Output: Definition, Measurement by application of Fick's principle and factors affecting cardiac output. Starling's law of heart. Blood pressure: Definition, concept of high and low blood pressure. Factors affecting blood pressure. Electrocardiography: The concepts of normal electrocardiogram (ECG), electrocardiographic leads and vectorial analysis. Electrical axis of heart.

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

Anatomy, tissue morphology and functional organization of the airways and the lungs. Mechanics of breathing: Concept of inspiration

and expiration, role of respiratory muscles and glottis. Compliance of lungs and chest wall, pressure- volume relationships, alveolar surface tension and surfactant, work of breathing. Spirometer and Spirometry: Definition, uses in the measurement of lung volumes and lung capacities. Physiological dead space. Pulmonary Circulation, Oxygen transport, Carbon-dioxide transport, Ventilation-perfusion ratio.

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

Anatomy, tissue morphology and functional organization of alimentary canal of higher vertebrates including humans. Digestive glands – Functional anatomy, tissue morphology of salivary glands, pancreas, liver. Physiology of deglutition. Movements of alimentary canal and their regulations (including the concept of enteric brain). 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: Basic Genetics [15 Marks]

Basic concepts of Mendelian Genetics. 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 (basic concept). Mitochondrial DNA. Epistasis, Penetrance, Expressivity, Pleiotropism. Karyotyping. Molecular Genetics: DNA structure, replication, transcription and translation in prokaryotes. Overview of gene expression and regulation, conceptof operon (lac Operon).

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.
3. 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 neuroglias. 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. Synapses: Definition, types, structure, Mechanism of synaptic transmission. Muscle: Microscopic and electron microscopic structure of skeletal, smooth and cardiac muscles. The sarcotubular 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, beneficialeffect, summation, refractory period, tetanus, fatigue.

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. Basic concept of spinal animal, its preparation and significance, Functions of the spinal cord. Cerebrospinal fluid (CSF): composition, formation, circulation, and functions.

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

Special Sense Organs. Characteristics of special senses, Sensory Coding- Weber-Fechner Law, Steven's Power Law. Audition- Structure of ear, auditory pathway, and the center associated with auditory perception, Mechanism of Hearing, Discrimination of sound

frequencies and intensities. Localization of sound source. Deafness. Olfaction and Gustation- Structure of the respective sense organs. Neural pathway associated with Olfactory and Gustatory sensation and centers in the brain involved. 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 the centers involved. 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]

Statistics in biology, its significance. Principles of statistical analysis of biological data (basic concepts) – concept of variable(s). 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 from toad by silver nitrate method.

(b) Staining of skeletal and cardiac muscle tissue sections by

methylene blue.
(c) Gastrocnemius-sciatic nerve preparation and kymographic recording of isotonic muscle twitch

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. Effect of temperature on muscle twitch.

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. Dietary management of obese, diabetic, and athletes. Population problem – principles and methods of family planning. Problem of Infertility and Assisted Reproductive Technologies (ART). Principles and social importance of immunization against diseases. Concept of Endemic, Epidemic and Pandemic. Etiology, epidemiology and prevention of Communicable Diseases, like, Cholera, Malaria, Dengue, Hepatitis, COVID-19 and AIDS. Non-communicable diseases - Hypertension and Obesity.

Unit –II: Detection and 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 and 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 environmental noise

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. Properties at the nano-scale (optical, electrical and mechanical properties). Types of nano-materials - Nanoparticles; metal, polymer and lipid nano particles. Carbon based nano-materials; fullerenes, carbon nano-tubes and graphene.

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: (a) Machine Language, (b) Assembly Language.

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: A comparative report on the basis of field survey of different physiological parameters (at least two parameters), their effects or variations in different community/population.
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. Hands-on experience MS Excel (data input, analysis, graph generation)- creating graphs and charts – Bar Graphs and Pie-chart. Introduction to statistical tools in excel – Mean, Median, Standard Deviation. Power-point presentation on field survey report.

Demonstrations:

1. Sterilization Methods (autoclaving, dry heat)
2. Handling and storage of microbial samples.
3. General microbes waste disposal protocol and 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, Excretory Physiology, Common Diseases of Gl System and 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: 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.

Unit –IV: Common Diseases of Gastrointestinal and 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. Kidney stone, glomerulonephritis. Renal dialysis. Non- excretory functions of the kidney. Urinary Tract Infections (UTIs).

Unit-V: Bioinformatics [15 Marks]

Introduction to Bioinformatics, Definition, History and Scope of Bioinformatics. Key applications in Physiology and Bio-Medical Sciences. Role of Bioinformatics in modern research. Biological Data-bases – Types of Data-Bases; (a) Protein (Structure) sequence databases (Uniprot/SwissProt/ TrEMBL, PIR), (b) Primary nucleotide sequence databases (NCBI, EMBL, DDBJ), Secondary nucleotide sequence databases (UniGene, SGD etc.)

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. Arneth Count, PCV, MCV, MHC, MCHC.
3. 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.

Demonstration:
1. Isolation and purification of DNA.

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 and their regulations.

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, MAFLD, NAFLD, NASH. 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 and ammonia.
2. Quantitative estimation of glucose by Benedict's Quantitative Method (percentage as well as total quantity to be done).
3. Paper Chromatography.

Demonstration:

1. Quantitative estimation of blood glucose using glucose oxidase-peroxidase (GOD-POD) method.

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, 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 Spares. 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 and avidity. Secondary interaction: precipitation and 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. Quantitative estimation of ascorbic acid in citrus fruits by titrimetric method (DCIP method).
4. Gram Staining

5. Double immunodiffusion (Ouchterlony method)
6. Study of haem agglutination – Direct Haem Agglutination Test (DHT).

Demonstrations:
1. Bacterial Culture Fundamentals: Culture media preparation, Aseptic technique, Pour plate method, Streaking and sub-culturing of bacteria.

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 and 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 and its application in physiology – II [15 Marks]
Simulation and 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

REVISED

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
	SEMESTER - III	**TH**	**PR**		
PHY-CC31-TH-P05	**Theory** (Blood and Body Fluids, Cardiovascular Physiology, Respiratory Physiology, Digestive System, Basic Genetics)	**03**	**00**	**03**	**75**
PHY-CC31-PR-P06	**Practical** (Blood and Body, Fluids,Cardiovascular Physiology, Respiratory, Physiology, Digestive System, BasicGenetics)	**00**	**01**	**01**	**25**
	Total	**03**	**01**	**04**	**100**

Course Code	Subject of the Course	Distribution of Credit	Total Credit	Marks	
	SEMESTER-IV	**TH**	**PR**		
PHY-CC41-TH-P09	**Theory** (Applied Hematology, Cardiovascular Disorders, Excretory Physiology, Common Diseases of Gl System and Excretory System and Bioinformatics)	**03**	**00**	**03**	**75**
PHY-CC41-PR-P10	**Practical (**Applied Hematology, Cardiovascular Disorders, Excretory Physiology, Common Diseases of Gl System and Excretory System and Bioinformatics)	**00**	**01**	**01**	**25**

PHY-CC42-TH-P11	**Theory** (Bioenergetics, Metabolism andCommon Metabolic Disorders)	**03**	**00**	**03**	**75**
PHY-CC42-PR-P12	**Practical** (Bioenergetics, Metabolismand Common Metabolic Disorders)	**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 contribution of Scientists in the field of Physiology, Cellular Basis of Physiology, Cellular transport, Chemistry ofBiomolecules)* in Semester – III and CC21 (*Cell signaling, Enzymes, Biophysiochemical principles)* in Semester – IV as published in the University ofCalcutta, 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, Basic Genetics]

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 inimmune 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-di- oxide 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: Basic Genetics [15 Marks]
Basic concepts of Mendelian Genetics. 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 (basic concept). Mitochondrial DNA. Epistasis, Penetrance, Expressivity, Pleiotropism. Karyotyping. Molecular Genetics: DNA structure, replication, transcription and translation in prokaryotes. Overview of gene expression and regulation, conceptof operon (lac Operon).

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 marksquestions 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.
3. 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, Excretory Physiology, Common Diseases of Gl System and Excretory System and Bioinformatics]

Unit-I: Applied Hematology, Blood and 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: 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-basebalance, 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.

Unit –IV: Common Diseases of Gastrointestinal and 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. Kidney Stone and glomerulonephritis. Renal dialysis. Non-excretory functions of the kidney. Urinary Tract Infections (UTIs).

Unit-V: Bioinformatics [15 Marks]

Introduction to Bioinformatics, Definition, History and Scope of Bioinformatics. Key applications in Physiology and Bio-Medical Sciences. Role of Bioinformatics in modern research. Biological Data-bases – Types of Data-Bases; (a) Protein (Structure) sequence databases (Uniprot/SwissProt/ TrEMBL, PIR), (b) Primary nucleotide sequence databases (NCBI, EMBL, DDBJ), Secondary nucleotide sequence databases (UniGene, SGD etc.).

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. Arneth Count, PCV, MCV, MHC, MCHC.
3. 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.

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 Spares. 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]