



UNIVERSITY OF CALCUTTA

Notification No. CSR/78/2026

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 his powers under 9(6) of the said Act, the Vice-Chancellor has, by an order dated 20.07.2026, approved the revised Complete syllabus of 4-year Honours & Honours with Research and 3-year MDC Courses of Studies in **Physiology** under **CCF, 2022**.

The above shall take effect from the Odd semester examinations, 2026 and onwards.

SENATE HOUSE

Kolkata-700073

21.07.2026

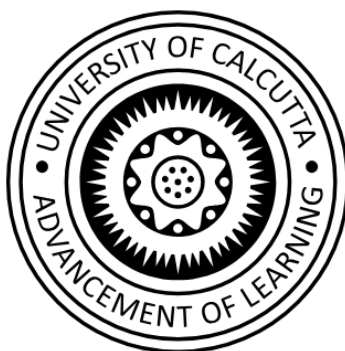
Prof.(Dr.) Debasis Das

Registrar

**CURRICULUM FRAMEWORK FOR UNDERGRADUATE
PROGRAMME
IN
PHYSIOLOGY**

REVISED SYLLABUS
(SEMESTER-I -VIII)

**FOR
4 YEARS HONOURS/ HONOURS WITH RESEARCH
AND
3 YEARS MDC COURSES IN PHYSIOLOGY
(Under Curriculum & Credit Framework, 2022, NEP)**



UNIVERSITY OF CALCUTTA
Undergraduate Board of Studies in Physiology

University of Calcutta

Programme Outcome (PO) of the 4yr UG. B.Sc. Programme

- ❖ **Disciplinary Knowledge:** Provide students with a robust foundation of human physiological systems from single cell to the complex interplay among organs and systems that sustains life, with a comprehensive understanding of Systemic Physiology along with their coordination and regulation in various health and disease conditions.
- ❖ **Scientific Reasoning & Problem-Solving:** Enable students to apply principles of biophysics, bioenergetics, enzyme kinetics, and integrated metabolism to explain and analyse critically diverse physiological phenomena and solve complex biological problems.
- ❖ **Interdisciplinary Integration:** Incorporate interdisciplinary insights from molecular biology, genetics, biotechnology, nanobiology, and bioinformatics to explore the molecular and cellular basis of physiological processes and thus to promote a system-level understanding of human function and application of the knowledge in diagnostics, therapeutics, and personalized medicine.
- ❖ **Research and Innovation:** Train students in hypothesis formulation, data acquisition, biostatistics, and research methodology, laboratory tools, advanced instrumentation, and domain-specific computer software to promote basic and advanced research in experimental physiology.
- ❖ **Community and Public Health Engagement:** Inculcate knowledge of epidemiology, preventive health care strategies, 'One Health' principles, and sustainability to address real-world challenges in health promotion and disease prevention. It fosters a sense of social responsibility among students.
- ❖ **Health and Wellness Orientation:** Explore transdisciplinary knowledge of yoga, traditional practices, and sustainability to contextualize health in a broader cultural and ecological perspective.
- ❖ **Application of core knowledge beyond laboratory:** Apply the knowledge of Physiology in areas of Exercise and Sports science, Occupational health, Environmental Stress Response, Space exploration, Ergonomic designing etc., offering a holistic perspective on the body's dynamic responses to different internal and external challenges.
- ❖ **Digital and technological skills for employability:** Equip students with advanced skills in biomedical instrumentation, clinical biochemistry, bioinformatics, AI applications, and data presentation tools for furthering physiological research h, and healthcare innovation. Huge opportunities of apprenticeship and training mentioned in UG curriculum will generate industry-ready skilled workforce. These experiential learning opportunities will also encourage entrepreneurial ventures and independent careers across diverse sectors, particularly within healthcare.
- ❖ **Ethical and Professional Competence:** Promote ethical conduct, and responsible use of technology in research, clinical practice, community interaction and to create awareness in Intellectual Property Rights.
- ❖ **Science Communication and Visualization:** Train students to effectively communicate physiological concepts through writing, illustration, presentations, and digital media tailored to both scientific and public audiences.
- ❖ **Global and Sustainable Perspectives:** Cultivate awareness and contextual understanding of Physiology in relation to global climate, environment, biodiversity, and Sustainable Development Goals.

Programme Specific Outcome (PSO) of 4 yr. UG Program in Physiology

Upon completion of the undergraduate programme in Physiology, students will acquire the followings:

- ❖ **Core Competency:** Demonstrate a comprehensive understanding of human physiology from cellular to systemic levels, including regulation and integration in health and disease states.
- ❖ **Analytical and critical thinking skill:** Apply core concepts of biophysics, bioenergetics, and metabolism to explain physiological functions and solve biological problems using critical thinking.
- ❖ **Multidisciplinary learning:** Develop multi Integrate interdisciplinary knowledge from molecular biology, biotechnology, genetics, and bioinformatics to understand the molecular mechanisms of human physiology.
- ❖ **Research Competency:** Formulate scientific hypotheses, conduct experiments, and analyse data using biostatistics and modern laboratory instrumentation.
- ❖ **Sense of Social Responsibility:** Apply physiological principles to public health issues, understand epidemiological trends, and promote disease prevention using the 'One Health and sustainability' approaches.
- ❖ **Idea of Holistic Health:** Contextualize health and wellness through yoga, traditional health practices, and ecological sustainability for holistic well-being.
- ❖ **Application of core knowledge:** Employ applied physiological knowledge in domains such as sports science, occupational health, ergonomics, environmental and stress physiology, and aviation and space biology.
- ❖ **Skill development:** Demonstrate proficiency in biomedical instruments, clinical biochemistry, bioinformatics, molecular biological techniques, computational and modelling tools to support research, diagnostics, and healthcare innovation, as well as the mandate of *Jivan -Koushal* -inclusion of life skill.
- ❖ **Ethics and professionalism:** Uphold ethical standards in research, community service, and professional practice, with awareness of intellectual property rights and responsible technology use.
- ❖ **Communication skills:** Communicate physiological concepts effectively through writing, illustration, presentations, and digital media for diverse audiences.
- ❖ **Sustainability and environmental consciousness:** Evaluate the role of physiology in global and ecological contexts, recognizing its relevance to climate change, biodiversity, food security, pandemic preparedness, and the Sustainable Development Goals.

University of Calcutta
Outline of UG Physiology Curriculum (1st Sem - 8th Sem)
(Major-Minor-MDC)

(Please refer to Annexure I & II for a detailed Credit structure of the Courses)

Semester-1

Paper	Course Code	Name of the Paper	Total Credit	Credit hours	Marks	Pg. No.
DSCC1	PHYM	General organization of Human body	3+1=4	75 hrs	100	10
SEC 1	PHYM	Laboratory methods in Microscopy and Clinical Haematology	2+2=4	90 hrs	100	11
MN 1	MPHY	General organization of Human body	3+1=4	75 hrs	100	42
CC1	MPHY-MDC-CC	General organization of Human body	3+1=4	75 hrs	100	42
SEC 1	MPHY-SEC	Clinical haematology, therapeutic nutrition, public hygiene, basic lab. techniques and food adulterants	2+2=4	90 hrs	100	44
IDC 1	PHYD	Elementary Physiology	2+1=3	60 hrs	75	43

Semester- 2

Paper	Course	Name of the Paper	Total Credit	Credit hours	Marks	Pg. No.
DSCC2	PHYM	Chemistry of Biomolecules Biophysical principle and Enzymes	3+1=4	75 hrs	100	12
SEC 2	PHYM	Clinical Biochemistry, Separation techniques and Environmental Physiology	2+2=4	90 hrs	100	14
MN 2	MPHY	Chemistry of Biomolecules and Enzymes	3+1=4	75 hrs	100	45
CC 2	MPHY-MDC-CC	Chemistry of Biomolecules and Enzymes	3+1=4	75 hrs	100	45
SEC 2	MPHY-SEC	Clinical haematology, Therapeutic Nutrition, Public hygiene, Basic Lab. techniques and Food adulterants	2+2=4	90 hrs	100	44
IDC 2	PHYD	Elementary Physiology	2+1=3	60 hrs	75	43

Semester-3

Paper	Course	Name of the Paper	Total Credit	Credit hours	Marks	Pg. No.
DSCC 3	PHYM	Digestive System, Nutrition and Dietetics	3+1=4	75 hrs	100	15
DSCC 4	PHYM	Metabolism	3+1=4	75 hrs	100	16
SEC 3	PHYM	Tools and Techniques in Community Physiology	2+2=4	90 hrs	100	17
MN 1	MPHY	General organization of Human body	3+1=4	75 hrs	100	42
CC 3	MPHY-MDC-CC	Digestive System, Nutrition, Dietetics and Metabolism	3+1=4	75 hrs	100	46

MDC-Mn-1	MPHY-MDC-Minor	General organization of Human body	3+1=4	75 hrs	100	42
SEC 3	MPHY-SEC	Clinical haematology, Therapeutic Nutrition, Public hygiene, Basic Lab. techniques and Food adulterants	2+2=4	90 hrs	100	44
IDC 3	PHYD	Elementary Physiology	2+1=3	60 hrs	75	43

Semester 4

Paper	Course	Name of the Paper	Total Credit	Credit hours	Marks	Pg. No.
DSCC 5	PHYM	Cardiovascular Physiology	3+1=4	75 hrs	100	18
DSCC 6	PHYM	Respiration & Physiology in altered environment.	3+1=4	75 hrs	100	20
DSCC 7	PHYM	Cell Signalling & Nerve Muscle Physiology,	3+1=4	75 hrs	100	21
DSCC 8	PHYM	Genetics and Molecular Biology	3+1=4	75 hrs	100	22
MN 2	MPHY	Chemistry of Biomolecules and Enzymes	3+1=4	75 hrs	100	45
CC 4	MPHY-MDC-CC	Cardiovascular, Respiratory, Nerve-Muscle and Renal Physiology	3+1=4	75 hrs	100	47
CC 5	MPHY-MDC-CC	Nervous and integumentary system, Environmental Physiology, Community & Public Health	3+1=4	75 hrs	100	49
MDC-Mn-2	MPHY-MDC-Minor	Chemistry of Biomolecules and Enzymes	3+1=4	75 hrs	100	45

Semester 5

Paper	Course	Name of the Paper	Total Credit	Credit hours	Marks	Pg. No.
DSCC 9	PHYM	Nervous system	3+1=4	75 hrs	100	23
DSCC 10	PHYM	Endocrinology	3+1=4	75 hrs	100	24
DSCC 11	PHYM	Reproductive Physiology and Developmental Biology	3+1=4	75 hrs	100	25
DSCC 12	PHYM	Community, Public and Occupational Health & Ergonomics	3+1=4	75 hrs	100	27
MN 3	MPHY	Digestive System, Nutrition, Dietetics and Metabolism	3+1=4	75 hrs	100	46
MN 4	MPHY	Cardiovascular, Respiratory, Nerve-Muscle and Renal Physiology	3+1=4	75 hrs	100	47
CC 6 (both CC1 & 2)	MPHY-MDC-CC	Special Senses, Endocrine and Reproductive Physiology	3+1=4	75 hrs	100	50
CC 7	MPHY-MDC-CC	Histology, Clinical Biochemistry, Molecular Biology, Evolution and	3+1=4	75 hrs	100	51

(for CC1 only)		Biostatistics				
MDC-Mn-3	MPHY-MDC-Minor	Digestive System, Nutrition, Dietetics and Metabolism	3+1=4	75 hrs	100	46
MDC-Mn-4	MPHY-MDC-Minor	Cardiovascular, Respiratory, Nerve-Muscle and Renal Physiology	3+1=4	75 hrs	100	47

Semester 6

Paper	Course	Name of the Paper	Total Credit	Credit hours	Marks	Pg. No.
DSCC 13	PHYM	Special Senses & Chronobiology	3+1=4	75 hrs	100	28
DSCC 14	PHYM	Excretory Physiology and Work & Sports Physiology,	3+1=4	75 hrs	100	29
DSCC 15	PHYM	Microbiology and Immunology	3+1=4	75 hrs	100	30
MN 3	MPHY	Digestive System, Nutrition, Dietetics and Metabolism	3+1=4	75 hrs	100	46
MN 4	MPHY	Cardiovascular, Respiratory, Nerve-Muscle and Renal Physiology	3+1=4	75 hrs	100	47
CC 7 (for CC2 only)	MPHY-MDC-CC	Histology, Clinical Biochemistry, Molecular Biology, Evolution and Biostatistics	3+1=4	75 hrs	100	51
CC 8 (both CC1 & 2)	MPHY-MDC-CC	Microbiology, Immunology, Work & sports Physiology, Ergonomics and Occupational Health	3+1=4	75 hrs	100	52
MDC-Mn-5	MPHY-MDC-Minor	Special Senses, Endocrine and Reproductive Physiology	3+1=4	75 hrs	100	50
MDC-Mn-6	MPHY-MDC-Minor	Microbiology, Immunology, Work & sports Physiology, Ergonomics and Occupational Health	3+1=4	75 hrs	100	52

Semester 7

(Common for Honours with research and without Research)

Paper	Course	Name of the Paper	Total Credit	Credit hours	Marks	Pg. No.
DSCC 16	PHYM	Biotechnology, Bioinformatics and Cancer Biology	4+0=4	60 hrs	100	32
DSCC 17	PHYM	Pharmacology, Toxicology & Stress Physiology	4+0=4	60 hrs	100	33
DSCC 18	PHYM	Advanced Sports Physiology, Ergonomics and Physiology in Space.	4+0=4	60 hrs	100	34
DSCC 19	PHYM	Practical Paper	0+4=4	120 hrs	100	35
DSCC 20	PHYM	Practical Paper	0+4=4	120 hrs	100	35

Semester 8
(For Honours without Research)

Paper	Course	Name of the Paper	Total Credit	Credit hours	Marks	Pg. No.
RM-1	PHYM	Research Methodology -I	3+1=4	60 hrs	100	36
RM-2	PHYM	Research Methodology II	3.+1=4	60 hrs	100	37
DSCC 21	PHYM	Evolution and Comparative Physiology	4+0=4	60 hrs	100	38
DSCC 22	PHYM	Ecology and Population Biology	4+0=4	60 hrs	100	39
Review	PHYM	Review work	3+1=4	60 hrs	100	40

Semester 8
(For Honours with Research)

Paper	Course	Name of the Paper	Total Credit	Credit hours	Marks	Pg. No.
RM-1	PHYM	Research Methodology -I	3+1=4	60 hrs	100	36
RM-2	PHYM	Research Methodology II	3+1=4	60 hrs	100	37
Research Internship	PHYM	Research Internship	3+1=4	75 hrs	100	41
Project work /Dissertation	PHYM	Project work /Dissertation	6+2=8	150 hrs	200	41

Abbreviations Used:

PHYM-	Physiology Major
MPHY-	Physiology Minor
DSCC-	Discipline Specific Core Course
SEC-	Skill Enhancement Course
IDC-	Interdisciplinary Course
MDC-	Multidisciplinary Course (3 Yrs.)
MN-	Minor paper (4 yrs.)
Mn-	Minor paper (3 Yrs)
CC-	Core Course (3 Yrs)

Marking Scheme Physiology Major

	Type	Paper(s)	Guidelines
1	DSCC papers of 100 marks (75 theory + 25 practical)	PHYM DSCC 1- to DSCC-15	DSCC Theory (75 Marks): Group-A Short definitive type-20 marks. 2 marks × 10 questions = 20 (15 questions to be set) Group-B Short notes -25 marks 5 marks × 5 questions =25 (8 questions to be set) Group-C Descriptive type-30 marks. 10 marks × 3 questions = 30 (6 questions to be set) DSCC Practical (25 marks): Experiments: 18 (Two experiments to be set), Viva-voce: 04, Lab. Notebook: 03 ** (For papers with Field work and Diet survey -10 marks (6+4), small project/review work-8 marks (5+3) along with one experiment to be set).
2	DSCC papers of 100 marks (Exclusive 100 marks theory paper only)	PHYM DSCC 16, 17, 18 (Common) & DSCC 23, 24 (Hons. without research only)	DSCC Theory (100 Marks): Group-A Short definitive type -30 marks 2 marks × 15 questions = 30 (20 questions to be set). Group-B Short notes -30 marks. 5 marks × 6 questions =30 (9 questions to be set). Group-C Descriptive type: 40 marks. 10 marks × 4 questions = 40 marks (7 questions to be set).
3	SEC papers of 100 marks (50 theory + 50 practicals)	PHYM SEC 1, 2 and 3	SEC Theory (50 marks) Group A- Short definitive type -10 marks. 2 marks × 5 questions = 10 (8 questions to be set). Group-B- Short Note -20 marks 5 marks x 4 questions =20 (7 questions to be set). Group-C- Descriptive type-20 marks) 10 marks × 2 questions = 20 (4 questions to be set). SEC Practical (50 marks): Experiments: 35 (At least two experiments to be set), Viva-voce: 8, Lab. Notebook: 7. For SEC -3 paper only, Epidemiological survey-11 (7+4), Diet survey-12 (8+4) along with one experiment (12 marks) to be set.
4	Research methodology (100 marks)	PHYM RM-1 (DSCC 21) RM-II (DSCC 22)	1. MCQs (75) 15 Multiple choice Questions (MCQs) x3 =45 15 Multiple choice Questions (MCQs) x2 =30 Viva-Voce=25
5	Exclusive Practical papers (100 marks)	PHYM DSCC 19 & DSCC 20	DSCC19: Full marks 100 Dales experiment-25, Human experiment -20, Staining: 25, Lab Notebook: 15, Viva: 15 DSCC 20: Full marks 100 Perfusion: 25, Histochemistry: 25, Human experiment: 20, Lab Notebook: 15, Viva: 15

Physiology Minor & MDC

	Type	Paper(s)	Guidelines
1	CC and Minor papers of 100 marks (75 theory + 25 practical)	MPHY CC 1- to CC8 & Minor papers	CC / Minor Theory (75 Marks): Group-A Short definitive type-20 marks. 2 marks × 10 questions = 20 (15 questions to be set) Group-B Short notes -25 marks 5 marks × 5 questions =25 (8 questions to be set) Group-C Descriptive type-30 marks.

			10 marks $\times$ 3 questions = 30 (6 questions to be set) DSCC Practical (25 marks): Experiments: 18 (Two experiments to be set), Viva-voce: 04, Lab. Notebook: 03 For MDC CC3/MN-3, Diet survey -10 (6+4) along with one experiment. For MDC CC4/MN-4, Field Survey-10 (6+4) along with one experiment.
2	SEC paper of 100 marks (50 theory + 50 practicals)	MPHY-SEC	SEC Theory (50 marks) 4. Group A- Short definitive type -10 marks. 2 marks $\times$ 5 questions = 10 (8 questions to be set). 5. Group-B- Short Note -20 marks 5 marks $\times$ 4 questions =20 (7 questions to be set). 6. Group-C- Descriptive type-20 marks) 10 marks $\times$ 2 questions = 20 (4 questions to be set). SEC Practical (50 marks): Experiments: 35 (At least two experiments to be set), Viva-voce: 8, Lab. Notebook: 7.
3	IDC paper of 75 marks (50 theory and 25 practical)	PHYD	IDC Theory (50 marks) MCQ based (2 marks $\times$ 25 questions = 50 marks). IDC Practical (25 marks): Experiment: 18 (Two experiments to be set), Viva-voce: 04, Lab. Notebook: 03

Detailed Syllabus
PHYSIOLOGY HONOURS (MAJOR)

SEMESTER-I

DSCC 1
General Organization of Human Body

Total Credit: 4 (Theoretical-3 + Practical-1)

Credit Hours: Theoretical (3x15=45 hrs.) + Practical (2x15=30 hrs.) =75 hrs.

Marks Distribution: Theoretical (75) + Practical (25) = Total 100 marks

Learning Objectives (LO):

This course is designed to-

- 1) Provide a comprehensive foundation in the principles of Human Physiology from cells to body systems.
- 2) Introduce the structural and functional organization of cells, and tissues, as the basis of physiological processes.
- 3) Familiarize students with fundamental anatomical concepts of human body.
- 4) Develop an understanding of body fluid homeostasis and blood physiology.

DSCC1 THEORY

75mark/45 hours

- **Physiology as a Basic science:** Evolution, scope, and historical recognition of Physiology as a Basic Science. Holistic understanding of complex interactions between cells, organs, and systems, explaining human health, and disease from evolutionary, environmental, ecological, and behavioural perspectives. Concept of *milieu intérieur*.
- **Cellular Physiology:** Physical structure of model membranes, lipid bilayer, membrane proteins. Membrane asymmetry and fluidity. Membrane transport: Diffusion, Osmosis, Passive and Active (primary and secondary). Ion pores, ion channels, ion pumps, and ionophores. Vesicular transport—phagocytosis, pinocytosis, transcytosis. Liposome. *Intracellular organelles:* Structure and function of mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, ribosome, and peroxisome. GERL system. Nucleus and its organization. Cytoskeleton and its role in motility. *Organization of chromosomes:* Structural organization of chromatin and chromosome. Nucleosome model. Heterochromatin and euchromatin. Cell division: Mitosis and meiosis. Cell cycle-steps. Apoptosis, necrosis, and autophagy.
- **Mammalian Tissue:** General characteristics, structure, distribution, and functions of epithelial, connective, muscular, and nervous tissue. Cell to cell junctions- types and functions. Cell adhesion molecules.
- **General Anatomy of Human Body:** Anatomical planes of the human body. Skeletal system- axial and appendicular. Abdominal regions (topographic), Body cavities (abdomino-pelvic, thoracic, cranial, and vertebral). Serous membranes (pleura, pericardium, peritoneum, and peritoneal folds). General anatomy of skeletal muscle-origin, insertion & belly. Fascicle Orientation. Classification of skeletal muscle based on action- agonist, synergist, antagonist & fixator.
- **Body fluids and Haematology:** Concept of body fluid compartments. Formed elements of blood-structure and functions. Plasma proteins- origin, types, and functions. Plasmapheresis. Bone marrow. Haemopoiesis- erythropoiesis, leukopoiesis and thrombopoiesis. Factors regulating erythropoiesis Blood volume – determination by dye dilution. Body fluid disorders- edema. Hemoglobin- structure, biosynthesis, and catabolism. Compounds and derivatives of hemoglobin. Hemostasis—definition and stages. Blood coagulation- factors and pathways. Fibrinolysis. Procoagulants and anticoagulants. Lymph composition, formation, circulation, and functions.

■ **DSCC 1 Practical**

25 Marks/30 hours

1. Staining of fresh tissues: Squamous and cornified epithelial cells in methylene Blue.
2. Preparation and staining of blood film with Leishman's stain and identification of formed elements of blood.
3. Estimation of Haemoglobin by Drabkin's method.
4. Preparation of Haemin Crystal.
5. Identification of anatomical planes and muscles from photographs: Anatomical planes-sagittal, frontal, and transverse. Muscles- masseter, platysma, sternocleidomastoid, trapezius, deltoid, latissimus dorsi,

pectoralis major, pectoralis minor, rectus abdominis, biceps femoris, biceps brachii, triceps brachii, gluteus maximus, gracilis, gastrocnemius and soleus.

■ **Course Outcome:**

After completing this course, students will be able to:

- 1) Explain fundamental concepts of Physiology as a basic science, including the concept of milieu intérieur.
- 2) Understand cellular organization, membrane transport, and cell cycle processes.
- 3) Identify the structure and functions of major mammalian tissues and cell junctions.
- 4) Demonstrate basic knowledge of human anatomy, including skeletal organization and body cavities.
- 5) Understand key haematological processes, including hemopoiesis and hemostasis.

SEC-1

Laboratory methods in Microscopy and Clinical Haematology

Total Credit: 4 (Theoretical-2 + Practical-2)

Credit Hours: Theoretical (2x15=30 hrs.) + Practical (4x15=60 hrs.) =90 hrs.

Marks Distribution: Theoretical (50) + Practical (50) = Total 100 marks

Learning Objectives (LO):

This course is designed to:

- Introduce the principles and applications of microscopy and histological techniques used in biological and biomedical sciences.
- Develop fundamental knowledge of haematological techniques.
- Provide an understanding of the pathophysiology, diagnosis, and evaluation of common haematological disorders.
- Familiarize students with blood group systems, transfusion medicine, and safe blood banking practices.
- Overall, build laboratory competency in histological and haematological methods essential for clinical diagnostics, physiological research and healthcare applications.

SEC 1 Theory

50 mark/30 hours

- **Microscopy:** Fundamentals of Microscopy- resolution, Abbe's law, magnification, contrast, and numerical aperture. Principles of image formation. Köhler illumination principle. Types of contrast generation: brightfield, darkfield, and differential. Principles of construction, uses, advantages, and disadvantages of optical microscopes—compound microscope phase contrast microscope, fluorescence microscope (upright and inverted), and electron microscope (SEM & TEM).
- **Histological Techniques:** Tissue fixation—objectives, classification, and examples of physical and chemical fixatives. Choice of fixatives. Fixation artifacts. Decalcification. Dehydration—steps and significance. Clearing agents and significance. Embedding: paraffin wax, resin. Microtomy: working principle and uses of rotary, rocking, cryostat microtome, and ultramicrotome. Section cutting. Dyes and stains in histology and histochemistry: types and examples of natural, synthetic, acidic, basic, neutral, and amphoteric dyes. Principle, procedure, and importance of different staining techniques—progressive, regressive, vital, and supravital. Direct and indirect staining. Mordants and accentuators.
- **Haematological Techniques:** Haemocytometer, parts and uses. Normal values, variations, and clinical significance of Total Count of RBC, WBC and platelets, Differential count, Arneeth count. Concept of complete hemogram. Determination and significance of PCV and red blood cell indices-MCV, MCH, MCHC, ESR- Westergren method. Clinical significance of polycythemia, leukocytosis, leukopenia, thrombocytopenia. Automated haematological analyzer- Coulter principle and Optical analysis. Bone marrow aspiration and staining by Giemsa and Perls Prussian Blue.
- **Haematological disorders:** Anemia- classification, diagnostic criteria, and management. RBC enzymopathies: G6PD deficiency, pyruvate kinase deficiency. Abnormal RBC morphology—anisocytosis and poikilocytosis. Hemoglobinopathies—sickle-cell anemia and thalassemia. Glycated hemoglobin. Leukaemia, lymphoma and purpura-types and significance. Bleeding time and clotting time. Acquired and

inherited bleeding and clotting disorders -DIC, Vitamin K deficiency bleeding, Haemophilia, Von Willebrand disease. Hyper coagulopathy. Fibrinogen degradation product and D-dimer. Thrombolytic and other thrombolytic agents.

- **Blood Groups and Blood Transfusion:** Blood groups—ABO, Bombay blood group, Rh. Other minor blood groups-Kell, Duffy, MN. Cross-matching techniques and their clinical significance. Concept of blood bank. Blood donation criteria. Apheresis-RBCs, WBCs, plasma, platelets. Cryoprecipitate. Storage conditions and shelf life of blood components. Blood transfusion-indication, precaution, and hazards. Erythroblastosis fetalis. Autologous transfusion. Complement therapy.

SEC 1 Practical

50 marks/60 hours

- 1) Determination of Total count of RBC and WBC from human blood.
- 2) Differential count of WBC from peripheral human blood smears.
- 3) Calculation of RBC indices (MCV, MCH, MCHC) from supplied data and interpretation.
- 4) Identification of megakaryocyte in bone marrow smear (Leishman stain) and measurement of diameter of megakaryocyte using micrometry.
- 5) Determination of bleeding time by Duke's method and clotting time by capillary tube method.
- 6) Staining of adipose tissue with Sudan III/IV.

Course outcome:

1. Upon successful completion of this course, students will be able to:
2. Explain the principles, construction, and applications of different microscopes and histological techniques used in biomedical investigations.
3. Perform and interpret routine haematological investigations and correlate laboratory findings with normal physiology and disease conditions.
4. Interpret blood group systems, and compatibility testing, to ensure safe and effective transfusion.
5. Apply laboratory principles and skills in histology in physiological research.

Semester 2

DSCC 2

(Biomolecules, Biophysical principles, & Enzymes)

Total Credit: 4 (Theoretical-3 + Practical-1)

Credit Hours: Theoretical (3x15=45 hrs.) + Practical (2x15=30 hrs.) =75 hrs.

Marks Distribution: Theoretical (50) + Practical (50) = Total 100 marks

Learning Objectives (LO):

- 1) Students will be able to apply biophysical principles such as pH, colloidal properties, and the laws of thermodynamics, kinetics, and quantum mechanics to explain biological processes
- 2) Students will be able to describe the structure, function, and chemical reactivity of essential biomacromolecules such as carbohydrates, proteins, and lipids.
- 3) Students will be able to analyze enzyme structure–function relationships, mechanisms of substrate specificity, enzyme kinetics, and regulation, and evaluate the influence of environmental factors such as pH and temperature on enzyme activity.

DSCC 2 Theory

75 marks / 45 hours

- **Biophysical Principles:** Concept of pH-definition, Henderson-Hasselbalch equation, physiological buffer systems, determination of pH by pH-meter-glass electrode method. Colloids-types, optical, electrical and electrokinetic properties. Thermodynamics- Laws of thermodynamics, physiological steady state, concept of Gibbs free energy.
- **Chemistry of Biomolecules:**

Carbohydrates: Definition, classification, and physiological importance. Monosaccharides- classification, structure, stereoisomerism, optical isomerism, optical activity and epimerism. Cyclic structures—Pyranose and furanose. Anomerism. Mutarotation and its mechanism. Chemical reactions of monosaccharides— reactions with concentrated mineral acids, alkali, phenyl hydrazine. Derivatives of monosaccharides -amino sugars, deoxy-sugar, sugar alcohols, sugar acids, and sugar esters. Disaccharides- maltose, lactose, and sucrose. Polysaccharides- starch, glycogen, dextrin, cellulose, glycoproteins, glycosaminoglycans, sialic acids, lectins. Blood group antigens.

Lipids: Definition and classification. Fatty acids- classification, systematic nomenclature, structures, and isomerism. Mono, di, and triglycerides. Properties of triacylglycerols-Melting point, Solubility, Emulsification, Hydrolysis, Saponification, Acetylation, Hydrogenation, Halogenations, Oxidation and Rancidity. Characterization of triacylglycerols-Saponification number, Acetyl number, Iodine number, Acid number, Reichert-Meissl number, Polenske number. Amphipathic lipids/sterol-Types and functions of phospholipids, glycolipids, and Lipoproteins; Cholesterol-structure and physiological significance.

Amino acids, Peptides, and Proteins: Amino acids-classification, structure, nomenclature, and optical properties. *Protonic equilibrium*- Zwitterions, Isoelectric point. Titration curve of glycine. Reactions with ninhydrin and formaldehyde. *Peptides & proteins*- structure and properties of peptide bonds- Phi & Psi angles. Reactions with Sanger's and Edman's reagents. Biuret reaction. Different levels of protein structure- primary, secondary (alpha helix and beta pleated sheet), tertiary and quaternary. Ramachandran Plot. Forces stabilizing protein structures. Denaturation.

- **Enzymes:** Enzymes classification. EC nomenclature. Concept of apoenzyme, holoenzyme, coenzyme, cofactors, and prosthetic group. Rate-limiting enzymes. Specificity of enzymes. Enzyme-substrate complex. Mechanism of enzyme action- activation energy and transition state. Models of enzyme-substrate interactions. Concept of initial rate, maximum velocity, and steady-state kinetics. Michaelis-Menten equation. Graphical representation of hyperbolic kinetics. Significance of K_m , V_{max} , K_{cat} . Catalytic efficiency. K-and M-series. Linear transformation of hyperbolic kinetics- Lineweaver-Burk plot. Factors influencing enzyme-catalyzed reactions- substrate concentration, enzyme concentration, pH, and temperature. Enzyme inhibition-competitive, non-competitive, uncompetitive and Feedback inhibitions. Regulation of enzyme activities- covalent modifications. Allosteric enzymes-types, Sigmoid saturation kinetics and Hill equation. Isozymes. Ribozyme and abzyme.

DSCC2 Practical

25 marks/30 hours

1. Qualitative tests for identification of physiologically important substances- Hydrochloric acid, Lactic acid, Uric acid, Albumin, Peptone, Gelatin, Starch, Dextrin, Glucose, Fructose, Lactose, Sucrose, Urea, Acetone, Glycerol, and Bile salt.
2. Preparation of phosphate buffer (pH 6, 6.8, and 7.4) using Henderson Hasselbach equation and measurement of pH using pH meter.
3. Preparation of N/10 -Oxalic acid, NaOH, H₂SO₄, HCl.
4. Determination of the strength of supplied NaOH solution by titrating against standard N/10 oxalic acid.
5. Quantitative estimation of the percentage of amino nitrogen in supplied glycine solution by Sorensen's Formol Titration Method.

Course Outcome

Upon completion of the course the student will be able to-

1. Explain and apply fundamental chemical principles to interpret complex physiological phenomena.
2. Classify and describe the structure, properties, and biological functions of major biomolecules such as carbohydrates, proteins, and lipids.
3. Analyze enzyme kinetics and evaluate the effects of factors such as pH and temperature on enzyme activity in relation to physiological processes.

SEC 2

Clinical Biochemistry, Separation Techniques and Environmental Physiology

Total Credit: 4 (Theoretical-2 + Practical-2)

Credit Hours: Theoretical (2x15=30 hrs.) + Practical (4x15=60 hrs.) =90 hrs.

Marks Distribution: Theoretical (50) + Practical (50) = Total 100 marks

Learning Objectives (LO):

- 1) Explain and analyze the pathophysiology of major blood-related and metabolic disorders and interpret their effects on hematological parameters.
- 2) Explain the principles of clinical enzymology and interpret enzyme levels and activities in body fluids (serum/plasma) for the diagnosis, monitoring, and evaluation of various diseases.
- 3) Describe and apply the fundamental principles of separation techniques to isolate and purify biomolecules from complex biological mixtures.
- 4) Classify and explain different types of food additives and evaluate their functional roles in improving food preservation, texture, flavor, and appearance.
- 5) Identify and analyze major sources of environmental pollution (air, water, soil, and noise), assess their impacts on ecosystems and human health, and propose appropriate mitigation strategies

SEC 2 Theory

50 marks /30 hours

- **Clinical Haematology:** Blood sampling methods: coagulated and anticoagulated blood, choice of coagulants, and sample storage. Blood glucose—fasting, postprandial, and random, hyper & hypoglycaemia, oral glucose tolerance test, HbA1C. Lipids-lipid profile, hypercholesterolemia, and hyperlipoproteinemia, atherosclerosis. Proteins- total protein, serum albumin, hypoalbuminemia, hypoproteinaemia, albumin: globulin ratio. Renal function test-serum urea, creatinine, uric acid. Serum bilirubin. C-Reactive Protein (CRP). Serum electrolytes- sodium, potassium, chloride.
- **Clinical Enzymology:** Pathophysiological significance of serum enzymes- lactate dehydrogenases (LDH1-LDH5), creatine kinase, pancreatic amylase, pancreatic lipase, acid phosphatase, alkaline phosphatases, Regan isoenzyme, β -glucuronidase, alanine transaminase, aspartate Transaminases, γ -glutamyl transferase.
- **Separation Techniques:** Principles, methods and applications of centrifugation, density-gradient centrifugation, ultracentrifugation. Dialysis. Chromatography-principles, methods and uses of paper chromatography, thin layer chromatography, HPLC. Electrophoresis-principle, method and uses of agarose gel electrophoresis, SDS-PAGE, and Iso-electric focusing (IEF). Blotting techniques- Southern blot, Northern blot, Western blot. Autoradiography.
- **Food Additives and Adulterants:** Food additives-definition and classification with examples. Preservatives. Food adulterants-definition, classification. Common adulterants in Food samples-milk, honey, ghee, butter, coffee, turmeric powder, chili powder, mustard seed/oil, besan and black pepper. Pathophysiological effects-metanil yellow, Rhodamine B, saccharin, monosodium glutamate, malachite green, margarine.
- **Environmental Pollution:** Pollution definition. Pollutants—classification. Air pollution—sources and effects on human health and control measures. Water pollution—sources and impacts on human health. BOD and COD. Noise pollution—permissible ambient noise levels, impacts on humans, and control measures.

SEC 2 PRACTICAL

50 marks/60 hours

1. Clinical biochemistry: Estimation of Blood glucose by Folin Wu method,
2. Estimation of Serum protein by Biuret method,
3. Estimation of Serum albumin (BCG method) and A:G ratio.

Course Outcome:

On completion of the course the student will be able to

- 1) Gain in-depth knowledge of the pathophysiology of major blood-related and metabolic disorders such as diabetes mellitus, hyperlipidemia, and renal failure, and interpret their effects on hematological parameters.
 - 2) Gain comprehensive knowledge of clinically important enzymes present in body fluids and understand their diagnostic significance in different diseases.
 - 3) Develop practical skills in separation techniques (such as chromatography, electrophoresis, and centrifugation) to isolate and purify biomolecules from complex mixtures.
 - 4) Identify the major sources of environmental pollution (air, water, soil, and noise), assess their impacts on ecosystems and human health, and propose appropriate mitigation strategies.
4. Paper chromatography of amino acid solution.
 5. Detection of food adulterants-metanil yellow in laddu, chicory in coffee, malachite green in vegetables, chalk powder in sugar, starch in milk.

Semester 3**DSCC 3*****Digestive System, Nutrition and Dietetics***

Total Credit: 4 (Theoretical-3 + Practical-1)

Credit Hours: Theoretical (3x15=45 hrs.) + Practical (2x15=30 hrs.) =75 hrs.

Marks Distribution: Theoretical (75) + Practical (25) = Total 100 marks

Learning Objective:

This course is designed to:

- 1) Introduce the structural and functional organization of the gastrointestinal tract and accessory digestive glands.
- 2) Develop a comprehensive understanding of digestion, absorption, gastrointestinal motility, and the gut-brain axis.
- 3) Provide a scientific foundation in human nutrition, energy metabolism, and the physiological roles of macro- and micronutrients.
- 4) Familiarize students with the principles of balanced diet planning and nutritional assessment based on current ICMR recommendations.
- 5) Promote an understanding of gastrointestinal and nutritional disorders to strengthen the application of physiological principles in health promotion and disease prevention.

DSCC3 THEORY**75mark/45 hours**

- **Anatomy and Histology of Alimentary Canal:** Anatomy and histology of the alimentary canal. *Digestive glands:* Salivary glands, liver, pancreas, gastric glands, and intestinal glands- location, histology, and functions. *Digestive Juices:* Salivary, gastric, pancreatic, biliary, and intestinal secretion- composition, functions, and regulation of secretion. Enterohepatic circulation.
- **Digestion and Absorption of food:** Digestion and absorption of carbohydrates, proteins, and lipids. Movements of GI tract. Deglutition and Defecation. Concept of gut microbiome and gut brain axis. Probiotics, prebiotics, synbiotics and postbiotics Eubiosis and dysbiosis. Disorders- basic concepts of peptic ulcer, jaundice, gallstones, lactose intolerance, and irritable bowel syndrome (IBS).
- **Food and Macronutrients:** Constituents of food and their importance. Classification of nutrients and their functions. Macronutrient: *Carbohydrates*– types, glycaemic index, glycaemic load, and dietary fibers. *Proteins*- essential and limiting amino acid, nitrogen balance, biological value, protein efficiency ratio, net protein utilization, digestibility coefficient, PDCAAS, supplementary action of proteins, protein spacers. *Lipids*- saturated fatty acids, MUFA, PUFA, trans fats, omega-3 and omega-6 fatty acids. *Energy metabolism:* BMR-definition, factors affecting, Concept of total energy expenditure (TEE) and physical activity level (PAL). Specific dynamic action. Respiratory quotient.
- **Micronutrients:** *Vitamins*- classification, sources, requirements, chemistry, physiological functions, and deficiency symptoms of vitamin A, D, E, K, thiamine, riboflavin, niacin, pyridoxine, pantothenic acid, biotin, folic acid, cyanocobalamin, ascorbic acid, and inositol. Concepts of hypervitaminosis and antivitamin. *Minerals*- sources, physiological functions, and deficiency symptoms of calcium, phosphorus, iron, sodium, potassium, iodine, zinc, and fluorine.

- **Principle of Dietetics** Concept of RDA, EAR, EER, TUL based on latest ICMR guidelines. Balanced diet. Principle of formulation of balanced diet for growing child, adult man and woman, pregnant woman, and lactating woman as per ICMR guidelines. Diet surveys- types. Composition and nutritive values of common Indian foods: rice, pulses, milk, spinach, banana, egg, and fish. Physiology of starvation and obesity.

DSCC3 Practical**25 Marks/30 hours**

1. Study and identification of stained sections of different parts of the Digestive System: Tongue, Parotid gland, Submaxillary gland, Sublingual gland, Oesophagus, Stomach, Duodenum, Jejunum, Ileum, Large Intestine, Liver & Pancreas.
2. Quantitative estimation of free and total acidity in the supplied gastric juice.
3. Quantitative estimation of ascorbic acid in a supplied sample by DCPIP method.
4. Determination of TEE using Standard equation (as per ICMR guideline).
5. Formulation of diet chart for normal sedentary adult male and female, lactating and pregnant female (As per latest guidelines of ICMR).

Course Outcome:

Upon successful completion of this course, students will be able to:

- Explain the anatomy, histology, and physiological functions of the alimentary canal and digestive glands.
- Interpret the mechanisms of digestion, absorption, gastrointestinal motility, and the physiological significance of the gut microbiome and gut-brain axis.
- Evaluate the nutritional roles of carbohydrates, proteins, lipids, vitamins, minerals, and their contribution to energy metabolism and human health.
- Apply the principles of dietetics to formulate balanced diets according to ICMR recommendations.
- Correlate gastrointestinal physiology and nutritional concepts with common digestive and nutritional disorders, supporting evidence-based approaches to health.

DSCC4**Metabolism**

Total Credit: 4 (Theoretical-3 + Practical-1)

Credit Hours: Theoretical (3x15=45 hrs.) + Practical (2x15=30 hrs.) =75 hrs.

Marks Distribution: Theoretical (75) + Practical (25) = Total 100 marks

Learning Objectives:

This course is designed to:

- 1) Introduce the fundamental pathways of carbohydrate, lipid, and amino acid metabolism and their integration.
- 2) Develop an understanding of biological oxidation, energy production, and metabolic regulation at the cellular level.
- 3) Familiarize students with key regulatory enzymes, metabolic cycles, and bioenergetics underlying normal physiological functions.
- 4) Provide a conceptual framework for understanding the interrelationship among metabolic pathways during different physiological states.
- 5) Establish the biochemical basis of common inherited and acquired metabolic disorders and their physiological consequences.

DSCC4 THEORY**75mark/45 hours**

- **Carbohydrate metabolism:** Pathways, rate limiting steps, inhibitors (as applicable), energetics, and metabolic significance of Glycolysis, TCA Cycle, Gluconeogenesis, Glyceroneogenesis, Pentose Phosphate Pathway, Glycogenesis, and Glycogenolysis. R-L cycle. Glucose-alanine cycle. Cori cycle. Pyruvate Dehydrogenase complex. Amphibolic nature of TCA cycle. Anaplerotic reactions.

- **Lipid metabolism:** Pathways, rate limiting steps, energetics, and metabolic significance of β -oxidation of saturated fatty acids, and biosynthesis of saturated fatty acids. Biosynthesis of Triglycerides. Biosynthesis of Cholesterol. Biosynthesis of Phospholipids - phosphatidyl choline and phosphatidyl serine. Metabolism of Ketone bodies.
- **Amino acid metabolism:** Amino acid metabolism. Concepts of glucogenic and ketogenic amino acids, amino acid pool, deamination - oxidative and non-oxidative, trans deamination, decarboxylation, transamination. Urea cycle -metabolic pathway and energetics. One-carbon compounds and transmethylation.
- **Biological Oxidation:** Redox potential. High-energy compounds. Mitochondrial Electron Transport Chain- organization and functions of different components. Oxidative phosphorylation-Chemiosmotic hypothesis. Substrate level phosphorylation. Inhibitors and uncouplers of ETC.
- **Metabolic disorders:** Glycogen storage diseases. Dyslipidaemia, phenylketonuria.

DSCC4 Practical**25 marks/30 hours**

1. Estimation of blood glucose by GOD-POD method using biochemical kit.
2. Estimation of serum cholesterol by CHOD-PAP method using biochemical kit.
3. Estimation of serum urea by DAM method using biochemical kit.
4. Diabetes Risk Score assessment (Questionnaire method) in peer group.

Course Outcome:

On completion of the course-

- 1) Students will be able to explain and analyze the major pathways of carbohydrate metabolism and interpret their roles in maintaining blood glucose levels and energy homeostasis.
- 2) Students will be able to explain and analyze the pathways of lipid metabolism, and evaluate their significance in energy production and metabolic regulation.
- 3) Students will be able to explain the metabolic pathways of amino acids, including transamination, deamination, and the urea cycle, and assess their roles in nitrogen balance and metabolic homeostasis.
- 4) Students will be able to describe the mechanisms of biological oxidation, including the electron transport chain and oxidative phosphorylation, and analyze their role in ATP production and cellular energy metabolism.

PAPER: SEC-3***Tools and Techniques in Community Physiology***

Total Credit: 4 (Theoretical-2 + Practical-2)

Credit Hours: Theoretical (2x15=30 hrs.) + Practical (4x15=60 hrs.) =90 hrs.

Marks Distribution: Theoretical (50) + Practical (50) = Total 100 marks

Learning Objectives:

This course is designed to:

- 1) Introduce the fundamental principles of epidemiology, community nutrition, anthropometry, biostatistics, and public hygiene.
- 2) Develop the ability to assess nutritional status using anthropometric and epidemiological indicators.
- 3) Provide knowledge of statistical methods for collection, presentation, and interpretation of biomedical data.
- 4) Familiarize students with nutritional management of common disorders and evidence-based dietary interventions.
- 5) Promote awareness of public health, food and water safety, hygiene practices, and essential first-aid measures for community health.

SEC 3Theory**50Marks/ 30 hours**

- **Epidemiology:** Definition and applications of epidemiology. Data-primary and secondary sources. Study designs- cross-sectional, longitudinal and cohort studies -prospective and retrospective. Epidemiological concept of rate, ratios, and proportions. Definition of crude birth rate and crude death rate, infant, child & maternal mortality rates, under five mortality rate, life expectancy.

- **Community nutrition:** Nutritional requirement and dietary management of adolescence and geriatric population. Basic concepts of diet therapy. Classification of therapeutic diets based on nutrient restriction/modification, food, and texture. Nutritional concern and dietary management of obesity, diabetes, hypertension, and nutritional anaemias. Special diets-gluten free diet, lactose intolerance diet, renal diet, keto diet, DASH.
- **Anthropometry & Its Application:** Definition and types of anthropometry-Static, Dynamic and Newtonian. Standard postures. Common terminologies used in anthropometry. Different body dimensions measured in anthropometry and their applications. Assessment of nutritional status by anthropometry -weight for age, height for age, weight for height, head circumference, MUAC, BMI, WHR, and skinfold thickness.
- **Fundamentals of Biostatistics:** Definition, scope, and applications of biostatistics. Types of variables-qualitative and quantitative. Population and sample. Sampling techniques. Organisation of data. Presentation of data- frequency distribution, pie diagram, bar diagram, frequency polygon, histogram. *Statistics of location:* mean, quantiles, percentile ranks, median, mode. *Measures of dispersion*-range, variance, standard deviation, interquartile range, quartile deviation, percent coefficient of variation. Standard error of the mean and confidence interval. Standard score-z score.
- **Public Hygiene and First Aid:** Awareness about food and water safety. Sources and potability of water. Water and food borne infections. Causative factors, symptoms, mode of transmission and methods of prevention of Hepatitis A, bacillary dysentery, rotavirus diarrhoea, amoebiasis, botulism. Hygiene – definition and types- personal, community, medical and culinary hygiene. Microbial Standards for Foods and Water. First Aid-definition and importance. Wounds-types, and management. Burns-types, severity assessment and management. Contents of an ideal first aid kit. Emergency response- CPR, and its steps. First aid in drowning and poisoning- snake bite, insect bites, and sting.

SEC 3 Practical**50 marks/ 60 hours**

1. Descriptive epidemiological study in campus/locality on any one of the followings- hypertension, hypotension, obesity, anaemia, undernutrition. Minimum sample size should be 30.
2. Diet survey of one's own family by 24 hours recall method / weighment method (7 days)
3. Anthropometric measurements- Weight. *Standing*-stature, elbow height. *Sitting*-height, shoulder height, elbow rest height, knee height, popliteal height, buttock popliteal length. *Segmental*- head length, head width, foot length, foot width. *Reach & span*- arm reach from wall, vertical reach. *Girth/circumference*- head circumference, mid upper arm circumference, waist circumference, and hip circumference.
4. Computation of mean, median, mode, standard deviation, standard error of mean. Plotting of pie diagram, histogram, frequency polygon from a given data set.
5. Data handling using MS Excel- Calculation of mean, median, standard deviation, standard error, 5th and 95th percentile. Plotting of a simple and stacked bar diagram, and pie diagram.
6. Demonstration: CPR technique and wound dressing.

Course Outcome

Upon successful completion of this course, students will be able to:

- 1) Apply epidemiological principles and demographic indicators to investigate health and disease patterns in populations.
- 2) Evaluate nutritional status and formulate dietary recommendations using anthropometric indices and therapeutic nutrition principles.
- 3) Analyze biomedical data using appropriate biostatistical methods and interpret statistical measures for health research.
- 4) Assess public hygiene practices and identify strategies for preventing food- and water-borne diseases.
- 5) Demonstrate basic first-aid skills and emergency response measures, including CPR and management of common medical emergencies, to promote community health and safety.

Semester-4**PAPER: DSCC-5****Cardiovascular Physiology**

Total Credit: 4 (Theoretical-3 + Practical-1)

Credit Hours: Theoretical (3x15=45 hrs.) + Practical (2x15=30 hrs.) =75 hrs.

Marks Distribution: Theoretical (75) + Practical (25) = Total 100 marks

Learning Objectives:

This course is designed to:

1. Provide a comprehensive understanding of the structure and functional organization of the heart and circulatory system.
2. Develop knowledge of cardiac electrophysiology, hemodynamics, and cardiovascular regulatory mechanisms.
3. Introduce the physiological principles underlying blood flow, blood pressure, and regional circulation.
4. Familiarize students with cardiovascular diagnostic techniques, including electrocardiography and echocardiography.
5. Build a strong foundation for understanding the physiological basis, diagnosis, and prevention of common cardiovascular disorders.

DSCC 5 Theory

75 Marks/45 hours

- **Cardiovascular Physiology:** Anatomy of the heart. Properties of cardiac muscle. Stannius ligature. Origin and propagation of cardiac impulse. Cardiac cycle: Events, Pressure and Volume changes. Heart sounds and murmurs. Histology and characteristics of blood vessels- artery, vein, and capillary. Pulse- arterial and venous, Cardiac Output-definition, measurement using Fick's principle and factors affecting cardiac output. Starling's law of heart. Electrocardiography- normal electrocardiogram (ECG), electrocardiographic leads and vectorial analysis. Electrical axis of heart. Principle of Echocardiography.
- **Hemodynamics and Circulation:** Dynamics of blood flow. Haemorheology. Bernoulli's law, Poiseuille's law, Laplace's law. Reynold's number. Blood volume- determination and factors affecting. The pulse: Arterial and venous. General circulation and microcirculation. Coronary circulation- anatomy and peculiarities. Regional circulation (anatomy and peculiarities): cerebral, hepatic, and pulmonary circulation.
- **Cardiovascular regulation:** Innervation of heart and blood vessels. Baroreceptors and chemoreceptors. Cardiac and vasomotor centres. Short term and long-term regulation of cardiovascular functions. Cardiac reflexes-baroreceptor reflex, chemoreceptor reflex, Bainbridge reflex, Marey's reflex, Bezold-Jarisch reflex, Cushing reflex. Role of epinephrine, norepinephrine, ADH, renin-angiotensin-aldosterone system (RAAS), ANP. Local metabolic vasodilators. Cardiovascular adjustments after haemorrhage. Cardiovascular Homeostasis.
- **Blood pressure:** Blood pressure-definition and principle of measurement. Hypertension and hypotension. Factors affecting blood pressure. Regulation.
- **Cardiovascular disorders:** Causes and symptoms of cardiovascular disorders-cardiac arrhythmias, myocardial infarction, coronary artery diseases (arteriosclerosis and atherosclerosis), myocardial necrosis and myocarditis, cardiac hypertrophy, heart failure, ischemic heart disease, and aneurysm. Coronary bypass, coronary angioplasty.

DSCC5 Practical

25 marks/ 30 hours

1. Measurement of systolic and diastolic arterial blood pressure by sphygmomanometer and determination of pulse pressure and mean pressure.
2. a) Identification of major pulse points- carotid, brachial, radial, popliteal.
b) Determination of pulse rate
3. Kymographic recording of normal unperfused heart of toad at different drum speeds. Effects of warm and cold saline.
4. Recording and interpretation of electrocardiogram of college student.

Course outcome

Upon successful completion of this course, students will be able to:

1. Explain the anatomy, electrophysiology, mechanical events, and functional properties of the heart and blood vessels.

2. Interpret electrocardiograms, cardiac output, hemodynamic principles, and mechanisms regulating cardiovascular homeostasis.
3. Analyze neural, hormonal, and local mechanisms involved in the regulation of cardiac function and arterial blood pressure.
4. Describe the characteristics and physiological significance of systemic, coronary, cerebral, hepatic, pulmonary, and microcirculatory blood flow.
5. Correlate alterations in cardiovascular physiology with the pathogenesis, diagnosis, and clinical manifestations of major cardiovascular diseases.

PAPER: DSCC-6

Respiration and Physiology in Altered Environment

Total Credit: 4 (Theoretical-3 + Practical-1)

Credit Hours: Theoretical (3x15=45 hrs.) + Practical (2x15=30 hrs.) =75 hrs.

Marks Distribution: Theoretical (75) + Practical (25) = Total 100 marks

Learning Objectives:

This course is designed to:

- 1) Provide a comprehensive understanding of the anatomy, and functional organization of the respiratory system.
- 2) Develop knowledge of pulmonary ventilation, gaseous exchange, respiratory regulation, and acid-base homeostasis.
- 3) Introduce physiological adaptations to environmental stresses, including high altitude, deep-sea diving, heat, and cold.
- 4) Familiarize students with pulmonary function testing and the physiological basis of respiratory disorders.
- 5) Establish the foundation for understanding respiratory physiology in health, environmental adaptation, and clinical practice.

DSCC 6 Theory

75 Marks/30 hours

- **Respiratory airways and breathing:** Anatomy, tissue morphology and functional organization of the airways and the lungs. Composition of gases in inspired, alveolar and expired air. Mechanism of breathing. Role of respiratory muscles and glottis. Mechanical events. Compliance of lungs and chest wall. Pressure- volume relationships, Alveolar surface tension and Surfactant. Work of breathing. Spirometry: Lung volumes and lung capacities. Dead space. Pulmonary ventilation and ventilation-perfusion ratio.
- **Gaseous exchange:** Partial pressure and composition of normal atmospheric gases in inspired, expired, alveolar air and blood. Oxygen transport. Carbon-dioxide transport. Oxy-hemoglobin and oxy myoglobin dissociation curve and factors affecting. Carbon dioxide dissociation curve. Bohr effect, Haldane effect. Non-respiratory functions of lungs.
- **Regulation of respiration:** Neural Control- Respiratory centres in the medulla and pons. Pre-Botzinger complex. Chemical control-role of central and peripheral chemoreceptors. Respiratory reflexes-Hering-Breuer reflex, J-receptor reflex, chemoreceptor reflex and cough reflex. Role of lungs in pH regulation. Respiratory acidosis, diabetic ketoacidosis. and alkalosis. Pulmonary function tests (PFTs) and its interpretation. Hypoxia- types and effects.
- **Physiology in altered environment:** Physiological response to high altitude- acute and chronic responses. Acclimatization to high altitudes. Acute mountain sickness. HAPE, HACE. Effect of hyperbaric environment- deep-sea diving. Decompression sickness (Caisson's diseases)- symptoms and preventive measures. Heat Stress and heat acclimatization. Heat disorders- types, symptoms, and prevention. Cold stress and Cold acclimatization. Frostbite.
- **Respiratory disorders:** COPD, asthma, emphysema, asphyxia, hyperpnoea, dyspnoea, sleep apnoea, cystic fibrosis, cyanosis, pneumonia, infant respiratory distress syndrome (IRDS). Periodic breathing - Kussmaul, Cheyne-Stokes, and Biot's breathing.

DSCC 6 Practical

25 marks/ 30 hours

1. Determination of blood oxygen saturation level by Pulse Oximeter.
2. Pulmonary function test using digital/manual spirometer.
3. Pneumographic recording of effects of talking, drinking, laughing, hyperventilation, and breath-holding on chest movements.
4. Pneumographic recording of the effect of hyperventilation on breath holding time.
5. Assessment of heat stress by WBGT index.

Course Outcome

Upon successful completion of this course, students will be able to:

- 1) Explain the structural and functional organization of the respiratory system, including the mechanics of breathing and pulmonary ventilation.
- 2) Interpret the physiological mechanisms of gaseous exchange, respiratory gas transport, and ventilation-perfusion relationships.
- 3) Analyze neural and chemical regulation of respiration, pulmonary function tests, and respiratory acid-base balance.
- 4) Evaluate physiological adaptations and acclimatization to altered environments such as high altitude, hyperbaric conditions, heat, and cold.
- 5) Correlate respiratory physiological alterations with the pathogenesis, and manifestations of common respiratory disorders.

DSCC7

Cell Signalling and Nerve-Muscle Physiology

Total Credit: 4 (Theoretical-3 + Practical-1)

Credit Hours: Theoretical (3x15=45 hrs.) + Practical (2x15=30 hrs.) =75 hrs.

Marks Distribution: Theoretical (75) + Practical (25) = Total 100 marks

Course Objective:

1. Students will be able to understand the structural and functional organization of neurons and nerve fibers, explain the mechanisms of nerve impulse generation and conduction, and analyze the processes involved in synaptic transmission and neural communication in the nervous system.
2. Students will be able to understand the structural organization and functional properties of different types of muscles, explain the physiological mechanisms of muscle contraction and relaxation, and analyze the roles of ions, ATP, and regulatory proteins in excitation-contraction coupling.

DSCC7 Theory:

75 marks/ 45 hours

■ Cell signalling:

Cell surface receptor proteins – ion channel coupled, G-protein coupled and enzyme-coupled. Intracellular messengers – cAMP, cGMP, IP₃, DAG, Ca²⁺, Protein kinases, CO, NO. Signal transduction pathways: Phosphatidylinositol, MAP kinase, JAK-STAT, SMAD.

- **Nerve Physiology:** Neurons, neuroglia, and nerves-classification, structures, and functions. Properties of nerve fibers. Myelination. Axoplasmic transport -anterograde and retrograde. Concepts of voltage gated ion channels. Patch clamp and voltage clamp experiments, Resting membrane potential-origin Nernst potential, Hodgkin-Huxley-Goldman-Katz constant field equation. Electrotonic potential. Action potential-ionic basis. Compound Action Potential. Propagation of nerve impulse. Current of injury. Synapse -types, structure, and properties. Synaptosomes. Neurotransmitters, co-transmitters, and neuromodulators. Molecular basis of synaptic transmission. EPSP, IPSP. Neuromuscular junction-structure, transmission, EPP, MEPP. Post-tetanic potential. Injury to peripheral nerves. Degeneration and regeneration in nerve fibers. Denervation hypersensitivity.

- **Muscle Physiology:** Microscopic and electron microscopic structure of skeletal, cardiac, and smooth muscles. Elastic components of muscles. Sarcotubular system. Red and white striated muscle fibers, Single and multi-unit smooth muscles. Muscle groups- agonists and antagonists. Properties of skeletal muscle.

Optimum load and optimum length of muscle fibers-basic concepts. Skeletal and smooth muscle contraction and relaxation-molecular basis, electrical, chemical, and thermal changes. Preload and afterload. Isometric and isotonic contractions. Muscle length-tension and force-velocity relationship. Electromyography and Myasthenia gravis.

DSCC7 Practical**25 marks/ 30 hours**

1. Histological staining of skeletal muscle and cardiac muscle with methylene blue.
2. Histological staining of Node of Ranvier by silver nitrate.
3. Kymographic recording of isotonic muscle contraction in sciatic-gastrocnemius preparation of toad.
4. Kymographic recording of the effect of two loads on simple muscle curve of toad. Calculation of work done by the muscle.

Course Outcome:

Upon completion, the student will be able to do

- 1) After completing this module, students will be able to describe the structural organization and functional properties of neurons and nerve fibers, explain the mechanisms of resting membrane potential, action potential, and nerve impulse conduction, analyze the process of synaptic transmission and the role of neurotransmitters in neural communication
- 2) After completing this module, students will be able to describe the structural organization and types of muscles (skeletal, cardiac, and smooth) and their functional characteristics,
- 3) Explain the mechanism of muscle contraction and relaxation based on the sliding filament theory, analyze the process of excitation-contraction coupling and the role of calcium ions, ATP.

DSCC 8**Genetics and Molecular Biology**

Total Credit: 4 (Theoretical-3 + Practical-1)

Credit Hours: Theoretical (3x15=45 hrs.) + Practical (2x15=30 hrs.) =75 hrs.

Marks Distribution: Theoretical (75) + Practical (25) = Total 100 marks

Learning Objectives:

This course is designed to:

- 1) Provide a strong foundation in molecular genetics, emphasizing the structure, function, and organization of nucleic acids and genes.
- 2) Develop an understanding of DNA replication, repair, transcription, translation, and regulation of gene expression.
- 3) Introduce the principles of classical, molecular, and human genetics, including chromosomal inheritance and genetic variation.
- 4) Familiarize students with the molecular basis of mutations, chromosomal abnormalities, and their significance in human health and disease.
- 5) Build the conceptual framework for applying genetic principles in biomedical research, genetic diagnosis, and personalized medicine.

DSCC 8 THEORY**75mark/45 hours**

- **Conformation of Nucleic acid:** Chemistry of purine, pyrimidines, and structural organization of A, B and Z DNA. Denaturation and annealing. Hyperchromicity, melting temperature and half Cot value. Nuclear and Mitochondrial DNA. Structure and function of mRNA, rRNA, and tRNA.
- **Concept of Gene and Mutation:** Gene and genome. Coding and non-coding genes. Alleles. Basic concept of gene interaction-epistasis, penetrance, expressivity, crossing over, linkage, recombination and pleiotropism. Mutation and mutagens. Structural and numerical alterations of chromosomes- deletion, duplication, inversion, translocation, aneuploidy, and polyploidy. Gene mutation- point and frameshift mutations and their genetic implications.
- **DNA replication and Repair:** Concepts of central dogma in molecular biology. Messelson-Stahl experiment. DNA replication in prokaryotes- enzymes involved, replication origin and replication fork. DNA damage and repair mechanisms.
- **Transcription and Translation:** Transcription in prokaryotes. Transcription factors. RNA polymerases. Post transcriptional modifications. Coding and non-coding RNAs. Transcriptome and its application.

Genetic code and its characteristics. Wobble hypothesis and its significance. Translation in prokaryotes. Post translational modifications. Regulation of Gene Expression in prokaryotes. Operon concept- *lac* operon.

- **Chromosomal inheritance and Human Genetics:** Mendelian principles and Laws of inheritance. Non-mendelian inheritance- codominance. Genetics of ABO blood group system. X-chromosome inactivation in human females. Pedigree analysis of key inheritance patterns- autosomal (dominant and recessive), x-linked (dominant and recessive), and y-linked with examples. Extrachromosomal inheritance- mitochondrial DNA. Karyotyping for chromosomal abnormalities-Down, Turner, and Klinefelter syndrome.

DSCC 8 Practical

25 Marks/30 hours

1. Isolation of DNA from banana/onion.
2. Estimation of DNA by DPA method.
3. Estimation of RNA by orcinol method.
4. Pedigree analysis of Colour blindness, ABO blood group.
5. Identification of chromosomal aberration in humans from Karyotype photographs- Down Syndrome, Turner Syndrome, and Klinefelter Syndrome.
6. Identification of Davidson body in peripheral blood neutrophils using Giemsa.

Course Outcome:

After completing this course, students will be able to:

- 1) Understand the conformational variations of nucleic acids.
- 2) Interpret the concept of genes and mechanism of mutation, including chromosomal aberrations.
- 3) Describe the processes of DNA replication, transcription, and translation within the framework of the central dogma.
- 4) Analyze the regulation of gene expression in prokaryotes, taking the operon model.
- 5) Apply the principles of human genetics to understand inheritance patterns and chromosomal disorders.

Semester -5

DSCC9

Nervous system

Total Credit: 4 (Theoretical-3 + Practical-1)

Credit Hours: Theoretical (3x15=45 hrs.) + Practical (2x15=30 hrs.) =75 hrs.

Marks Distribution: Theoretical (75) + Practical (25) = Total 100 marks

Learning Objectives:

This course is designed to:

- Provide a comprehensive understanding of the structural and functional organization of the central and autonomic nervous systems.
- Develop knowledge of sensory receptors, neural pathways, reflex mechanisms, and motor control.
- Introduce the functional organization of different brain regions involved in sensory, motor, autonomic, and cognitive functions.
- Familiarize students with the physiological basis of learning, memory, language, emotion, and sleep.
- Establish the foundation for understanding neurological disorders through the application of integrative neurophysiological principles.

DSCC 9 Theory:

75 marks/45 hours

- **General Organization of Nervous System:** Brain and spinal cord- structural organization of different parts, Receptors- definition, classification, and properties. Receptor potential. Muller's law of specific nerve energies. Weber-Fechner law, Steven's power law. Reflex action- definition, reflex arc, classification, and properties. Babinski's sign. Syringomyelia. Autonomic nervous system- outflow, ganglia, centers, functions. Effect of lesions of spinal cord-complete and incomplete transection and hemisection-Brown Sequard syndrome. Spinal animal. Chemical transmission in autonomic nervous system. CSF- formation, circulation, and functions. Blood-Brain Barrier and Blood-CSF Barrier. Lumbar puncture. Hydrocephalus. Cerebral circulation-anatomy and peculiarities. Cerebrovascular stroke.
- **Neural tracts:** Ascending and descending tracts- origin, courses, terminations, and functions. Proprioception and kinaesthetic sensation. Decerebrate and decorticate rigidity. Pain-nociception, neural pathway, and perception. Gate control theory. Referred pain. Analgesia-endogenous pain inhibitory system. Hyperalgesia.

- **Muscle spindle and Golgi-tendon organ:** Muscle spindle and Golgi-tendon organ -structure, innervations, and functions.
- **Brain:** Different parts of the brain-structures and functions of cerebral cortex, thalamus, hypothalamus, brainstem, cerebellum, reticular formation, basal ganglia. Causes and symptoms of hypotonia, rigidity, nystagmus, thalamic syndrome, Parkinson's disease, Huntington's chorea, Kluver Bucy syndrome. Thalamic animal.
- **Vestibular apparatus**-structure and functions.
- **Higher functions of brain:** Limbic system -structure, and functions. Papez circuit, higher control of limbic system. Emotion. Neural basis of Learning and Memory. Learning - types and neurological basis. Dementia and Alzheimer's disease. Memory-classification and molecular basis. Memory consolidation- role of hippocampus. Inter-cortical transfer of memory. Speech-organs and processes involved. Speech centers in the brain- Broca's and Wernicke's area, Speech aphasia. Neural pathways for comprehension and production of speech. Sleep-classification. EEG changes in various stages of sleep. Neural basis of REM and non-REM sleep.

DSCC 9 Practical**25 marks/30 hours**

1. Permanent slides-(12)- cerebral cortex, cerebellum, spinal cord, bone, hyaline cartilage, artery, vein, lung, trachea, kidney, ureter, skin.
2. Memory assessment using N-Back test (1-back).
3. Assessment of neurocognition by Montreal Cognitive Assessment (MOCA) test
4. Determination of visual reaction time by ruler drop test.
5. Determination of threshold distance for two-point discrimination.

Course Outcome:

After completing this module, students will be able to

- 1) *Describe the structural organization of the central and peripheral nervous systems and their functional roles in the body,*
- 2) *explain the mechanisms of neural communication, reflex action, and neural integration,*
- 3) *analyze the functional roles of different regions of the brain in regulating sensory, motor, and autonomic activities and*
- 4) *interpret the physiological basis of higher brain functions, including learning, memory, language, emotion, and behavior.*

DSCC-10
Endocrinology

Total Credit: 4 (Theoretical-3 + Practical-1)

Credit Hours: Theoretical (3x15=45 hrs.) + Practical (2x15=30 hrs.) =75 hrs.

Marks Distribution: Theoretical (75) + Practical (25) = Total 100 marks

Learning Objectives:

This course is designed to:

- 1) Provide a comprehensive understanding of endocrine glands, hormones, and mechanisms of hormonal regulation in human physiology.
- 2) Develop knowledge of neuroendocrine integration and hormonal control of growth, metabolism, reproduction, and homeostasis.
- 3) Introduce the biosynthesis, secretion, regulation, and physiological actions of major endocrine hormones.
- 4) Familiarize students with hormonal interactions among classical endocrine glands and emerging endocrine organs.
- 5) Build the foundation for understanding endocrine disorders and their physiological basis through integrated endocrine physiology.

DSCC 10 Theory**75 Marks/45 hours**

- **Introduction to Endocrinology:** General idea of Endocrine glands and hormones. Chemical nature and classification of hormones. Basic idea on intracellular mechanisms of hormone action.

- **Neuroendocrinology: Hypothalamus and Pituitary** Neuroendocrinology: Hypothalamus as master regulator— major hypothalamic nuclei involved in hormone regulation, neurosecretory cells. Hypothalamo-hypophyseal portal system. Hypothalamo-hypophyseal tract. Circumventricular organs— median eminence, organum vasculosum of lamina terminalis, area postrema, sub-fornical organ, sub-commissural organ. Hypophysiotropic releasing and inhibitory hormones. Concepts of neuroendocrine axis and feedback regulation.
Pituitary: Anterior and posterior pituitary gland- histology. Pituitary Hormones-chemical nature, mechanism of action, functions, and regulation of secretion. Disorders- Panhypopituitarism, dwarfism, gigantism, acromegaly, Cushing's disease, hyperprolactinemia, diabetes insipidus- neurogenic and nephrogenic, SIADH.
- **Pineal, Thyroid and Parathyroid Gland:** Pineal gland – Histological structure. Chemical nature, biosynthesis, molecular mechanism of action, functions and regulation of secretion of melatonin. Thyroid and Parathyroid Glands- histology. Hormones-chemical nature, biosynthesis of thyroid hormones, mechanism of action, functions and regulation of secretion. Disorders- Non-toxic goiter, myxoedema, cretinism, Hashimoto's thyroiditis, Grave's disease, tetany.
- **Adrenal Gland:** Adrenal cortex and medulla- histology. Hormones-chemical nature, mechanism of action, functions and regulation of secretion. Outlines of steroid biosynthesis in different cortical layers. Biosynthesis and catabolism of adrenal medullary hormones. Disorders-Cushing's syndrome, congenital adrenal hyperplasia, Addison's disease, Pheochromocytoma.
- **Endocrine Pancreas, Adipose tissue and Hormones in Metabolism:** Pancreatic islets- histology. Hormones- chemical nature, mechanism of action, functions and regulation of secretion. Hormones secreted from adipose tissues-types and functions and their role in energy metabolism. Appetite control, obesity and hormones. Disorders- Diabetes mellitus, hyperinsulinism, OGTT.
- **Hormones of G-I tract and other glands and organs:** Gastrointestinal hormones- chemical nature, mechanism of action, functions, and regulation of secretion of gastrin, CCK, secretin, ghrelin, motilin. Hormones secreted from heart, kidney, liver, thymus gland- chemical nature, functions, and regulation of secretion. CTGF, PDGF, NGF, Myokines, Osteokines- basic concept.

DSCC 10 Practical**25 marks/ 30 hours**

1. Identification of permanent slides-pituitary, adrenal, thyroid, thymus, pancreas, testis, ovary, uterus, lymph gland and spleen.
2. Measurement of external and internal diameter of thyroid follicle using micrometry.
3. Hematoxylin-Eosin staining of thyroid/adrenal/pancreas.
4. Estimation of random blood sugar by glucometer.

Course outcome**Course Outcomes (CO)**

Upon successful completion of this course, students will be able to:

- 1) Explain the organization of the endocrine system, hormone classification, mechanisms of hormone action, and neuroendocrine regulation.
- 2) Interpret the synthesis, secretion, physiological actions, and feedback regulation of hormones produced by major endocrine glands.
- 3) Analyze the endocrine regulation of growth, metabolism, fluid balance, energy homeostasis, and appetite.
- 4) Correlate hormonal dysfunction with the pathophysiology and clinical manifestations of common endocrine disorders.
- 5) Evaluate the integrative roles of endocrine, neuroendocrine, and peripheral endocrine organs in maintaining physiological homeostasis and health.

DSCC-11**Reproductive Physiology and Developmental Biology**

Total Credit: 4 (Theoretical-3 + Practical-1)
 Credit Hours: Theoretical (3x15=45 hrs.) + Practical (2x15=30 hrs.) =75 hrs.
 Marks Distribution: Theoretical (75) + Practical (25) = Total 100 marks

Learning Objectives-

This course is designed to:

- 1) Provide a comprehensive understanding of the anatomy, histology, and endocrine regulation of the male and female reproductive systems.
- 2) Develop knowledge of human reproduction, fertilization, pregnancy, parturition, and lactation as integrated physiological processes.
- 3) Introduce the principles of developmental biology, embryogenesis, stem cell biology, and foetal development.
- 4) Familiarize students with hormonal regulation of puberty.
- 5) Build a foundation for understanding reproductive, developmental, and congenital disorders from physiological and clinical perspectives.

DSCC 11 Theory

75 Marks/ 45hours

- **General idea on Reproduction and Male Reproductive System:** General components and basic anatomy of male and female reproductive systems. Sexual development after birth. Neuroendocrinology of onset of puberty and bodily changes during puberty, adrenarche, gonadarche, thelarche, spermatarche, pubarche, menarche. Menopause, male climacteric. Primary and accessory sex organs and secondary sex characters. Male reproductive tract, histology of testis, spermatogenesis, testicular hormones- chemical nature, synthesis, mechanism of action, functions, and regulation of secretion—hypothalamo-pituitary-testicular axis. Brief idea on disorders of male reproductive system- infertility, impotence, azoospermia, oligoasthenoterratozoospermia (OAT), benign prostatic hyperplasia and cryptorchidism.
- **Female Reproductive System:** Female reproductive tract. Anatomy and histology of ovary. Growth, development and function of the ovarian follicle, ovulation, formation, function and degeneration of corpus luteum. Ovarian hormones- chemical nature, synthesis, mechanism of action, functions, and regulation of secretion—hypothalamo-pituitary-ovarian axis. Human menstrual cycle and its regulation, Oestrous cycle. Abnormalities in menstrual cycle. Brief idea on female infertility, Polyendocrine Metabolic Ovarian Syndrome (PMOS) or PCOS, endometriosis, dysmenorrhoea, oligomenorrhoea.
- **Pregnancy & Lactation:** Sperm in female genital tract- capacitation, acrosomal reaction. Fertilization, membrane fusion, cortical reaction, early embryogenesis and implantation, Prevention of polyspermy and placentation. Structure and functions of placenta, endocrine and other physiological changes during pregnancy. Maintenance of pregnancy and brief idea on pregnancy related pathophysiology, pregnancy test. Physiology of parturition, development of mammary gland, lactation and its hormonal control.
- **Developmental Biology:** Basic idea of stem cells-properties, totipotent, pluripotent, multipotent. Types and properties of Stem Cell: Embryonic Stem Cells (ESCs). Adult Stem Cells. Induced Pluripotent Stem Cells (iPSCs). Cleavage and formation of morula. Types of cleavage based on plane and pattern. Blastocyst formation and implantation, Gastrulation and germ layer differentiation. Organogenesis: Development of heart, alimentary canal, urinary system, and genital system. Gonadal differentiation. Foetal circulation-anatomy and peculiarities. In utero development: Lifestyle and hormonal context. Ossification of bones. Common developmental defects- spina bifida, congenital heart disease and disorders- autism spectrum disorder, cerebral palsy. Teratogens.

DSCC 11 Practical

25 marks/ 30 hours

1. Hematoxylin Eosin staining of sections of ovary, testis, uterus.
2. Measurement of diameter of round seminiferous tubule and graafian follicle by micrometry.
3. Identification of Stages of Oestrous cycle from vaginal smear from permanent slides.
4. Identification of stages of Embryogenesis from photographs.
5. Group Project on assessment of risk of developing Polyendocrine Metabolic Ovarian Syndrome (PMOS) or PCOS among college students using standard questionnaire and body composition (BMI and WH ratio). (n=20)/Mini review on any aspects of PMOS (PCOS).

Course Outcome

Upon successful completion of this course, students will be able to:

- 1) Explain the anatomy, histology, endocrine regulation, and physiological functions of the male and female reproductive systems.
- 2) Interpret the hormonal mechanisms governing puberty, gametogenesis, menstrual cycle, pregnancy, parturition, and lactation.
- 3) Analyze the cellular and molecular events of fertilization, embryogenesis, stem cell biology, organogenesis, and foetal development.
- 4) Correlate developmental processes with fetal adaptations, placental physiology, and maternal physiological changes during pregnancy.
- 5) Relate abnormalities in reproductive and developmental physiology to infertility, endocrine disorders, congenital anomalies, and reproductive health conditions.

DSCC 12

Community, Public, and Occupational Health, & Ergonomics

Total Credit: 4 (Theoretical-3 + Practical-1)

Credit Hours: Theoretical (3x15=45 hrs.) + Practical (2x15=30 hrs.) =75 hrs.

Marks Distribution: Theoretical (75) + Practical (25) = Total 100 marks

Learning Objectives:

This course is designed to:

- 1) Provide a comprehensive understanding of health, disease, epidemiology, and their applications in community and public health.
- 2) Develop knowledge of communicable, non-communicable, nutritional, and emerging diseases from epidemiological perspectives.
- 3) Introduce the principles of reproductive health, family welfare, and national public health programmes.
- 4) Familiarize students with occupational health hazards, workplace ergonomics, and disease prevention strategies.
- 5) Promote awareness of the One Health approach and sustainable practices for improving individual, community, and environmental health.

DSCC 12 THEORY

75mark/45 hours

- **Changing concept of Health and Disease:** WHO definition of health and its determinants. Concept of Community health. Definition and applications of Epidemiology. Germ theory of disease. Epidemiological triad and its advanced model. Dynamics of disease transmission- endemic, epidemic, and pandemics. One health and sustainability.
- **Communicable and non-communicable diseases:** Epidemiology of communicable diseases. Host, agent, mode of transmission, clinical features and prevention of malaria, dengue, pneumonia, tuberculosis, hepatitis B and AIDS. General epidemiology of non-communicable diseases- diabetes and hypertension. Epidemiology of nutritional/ food related disease- malnutrition, marasmus & kwashiorkor, iron deficiency anaemia, xerophthalmia, iodine deficiency disorder, obesity. Epidemiology of emerging diseases- Ebola, Zika, Nipah, SARS, Covid-19.
- **Reproductive health and Family welfare:** Population explosion- factors responsible and hazards. Fertility indicators- general fertility rate (GFR) and total fertility rate (TFR). Principles and methods of family planning. Problem of infertility. Assisted reproductive technologies (ART). MCH: Causes and prevention of maternal mortality. Antenatal, intranatal, and postnatal care. Indicators of child mortality in India. Problem of low-birthweight. Govt. programs and policies- Janani Suraksha Yojana (JSY) and PM Poshan (Mid-day meal).
- **Public health:** Definition of public health. Public health challenges in India. Epidemiology of airborne diseases (chickenpox, measles, influenza). Waterborne diseases (typhoid fever, cholera), Food borne intoxications (aflatoxicosis, staphylococcus poisoning) and Food borne infections (salmonellosis, shigellosis).
- **Occupational Health & Ergonomics;** Definition of occupational health. Occupational environment and health hazards- physical, chemical, biological, ergonomic, psychosocial and safety hazards. Occupational diseases- asbestosis, silicosis, pneumoconiosis, byssinosis, bagassosis, and FLD. Work Related Musculo-

skeletal disorders (WRMSDs) - definition, types, and causes. Workplace injuries- types and causes. *Ergonomics*: definition, scope, and application. Ergonomic assessment of the workplace environment.

■ **DSCC 12 Practical**

25 Marks/ 30 hours

1. A handwritten report on Field survey on any of the following- physiological/ anthropometric / epidemiological study) taking at least three parameters.
2. Evaluation of socioeconomic status of a family using updated Kuppuswamy Scale.
3. Determination of dissolved oxygen by Winkler's method
4. Determination of illumination and sound level in the college premises (3-4 sites).

■ **Course Outcome:**

After completing this course, students will be able to:

- 1) Explain the concepts of health, disease, and epidemiology, with their determinants.
- 2) Explain epidemiology of major communicable and non-communicable diseases.
- 3) Interpret various reproductive health indicators and describe the components of MCH.
- 4) Evaluate public health challenges and disease prevention strategies relevant to the context of India.
- 5) Assess occupational health hazards and apply ergonomic principles for workplace health and safety.

Semester VI

DSCC13

Special Senses and Chronobiology

Total Credit: 4 (Theoretical-3 + Practical-1)

Credit Hours: Theoretical (3x15=45 hrs.) + Practical (2x15=30 hrs.) =75 hrs.

Marks Distribution: Theoretical (75) + Practical (25) = Total 100 marks

Learning Objective:

- Students will be able to understand the structure and functional mechanisms of the organs of special senses, including vision, hearing, taste, smell, and explain how sensory stimuli are detected, transmitted, and interpreted by the nervous system.
- Students will be able to understand the fundamental concepts of biological rhythms and their physiological significance, explain the mechanisms underlying circadian and other biological rhythms, **and** analyze the role of internal biological clocks and environmental cues (zeitgebers) in regulating physiological and behavioral processes

DSCC 13 Theory:

75 marks/45 hours

- **Fundamentals of Special Senses:** Concept of general and special senses. Characteristics of special senses. Sensory coding.
- **Chemical Senses:** Olfactory and gustatory pathway- receptor organs, neural pathways, and centers. Signal transduction of olfactory and gustatory stimuli. Olfactory and gustatory coding. After taste. Smell and taste disorders-ageusia, hypogeusia, anosmia, hyposmia.
- **Audition:** Audition: Sound waves, decibel. Structure and functions of auditory apparatus-external, middle and internal ears. Organ of Corti. Mechanism of hearing- auditory transduction and theories of hearing, auditory pathway. Different electrical potentials of the internal ear. Discrimination of sound frequency and loudness. Localization of sound sources. Audiometry. Deafness.
- **Vision:** Outline structure of eyeball. Lens. Mechanism of accommodation. Light reflexes. Argyll Robertson Pupil. Retina Errors of refraction and their corrections, cataract, astigmatism, presbyopia. Aqueous humor - formation, composition, circulation, and function. Vitreous humor. Glaucoma. Histology of retina peripheral retina, fovea, and blind spot. Photochemical changes in retina and photo transduction. Electrical changes in retina on exposure to light. Visual pathway. Effects of lesion in visual pathway. Photopic and scotopic vision. Positive and negative after images- contrast phenomenon. Light and dark adaptation. Colour vision -

trichromatic, single, and double opponent theories. Colour blindness. Visual field –perimetry. Visual acuity-factors affecting. Critical fusion frequency. Ferry-Porter Law.

- **Chronobiology:** Definition and examples of Physiological Rhythms- ultradian, circadian, and infradian. Basic concept of Free running rhythms. Differences between circadian and diurnal rhythms. Zeitgebers. Concepts of synchronization and desynchronization. Neuroendocrine basis of biological rhythm. Suprachiasmatic nucleus as Master clock- structure, afferent and efferent connections, neurotransmitters in relation to circadian rhythms. Peripheral clocks- Basic concept. Concept of time keeping genes. Endocrine biorhythms- cortisol, melatonin, prolactin. Diurnal variations-body temperature, sleep-wakefulness cycle. Chronotype-basic concept. Human biorhythm disorders-Jet-lag and shift work.

DSCC 13 Practical

25 marks/45 hours

1. Identification of cells space of cornea with silver nitrate.
2. Determination of Colour Blindness by Ishihara Chart.
3. Determination of Visual Acuity by Snellen's Chart.
4. Determination of Deafness by Tuning Fork Test.
5. Assessment of individual differences in human circadian rhythms (chronotype in human population) by Questionnaire method.
6. Determination of Circadian/ diurnal variation of body temperature.

Course Outcome:

After completing this module, students will be able to

- 1) Describe the structure and functional organization of the organs of special senses, including the eye, ear, nose, and taste buds,
- 2) Explain the mechanisms of sensory transduction involved in vision, hearing, olfaction, gustation, and equilibrium,
- 3) Analyze the neural pathways involved in transmitting sensory information from sensory organs to the brain and
- 4) Interpret the physiological basis of sensory perception and the integration of sensory information in the central nervous system.

DSCC-14

Excretory Physiology and Work & Sports Physiology

Total Credit: 4 (Theoretical-3 + Practical-1)

Credit Hours: Theoretical (3x15=45 hrs.) + Practical (2x15=30 hrs.) =75 hrs.

Marks Distribution: Theoretical (75) + Practical (25) = Total 100 marks

Learning Objectives:

This course is designed to:

- 1) Provide a comprehensive understanding of renal physiology, thermoregulation, work and exercise physiology.
- 2) Develop knowledge of the physiological mechanisms regulating fluid balance, physical work, and exercise performance.
- 3) Introduce the principles of assessment of renal function, exercise testing, and evaluation of physical fitness.
- 4) Familiarize students with physiological adaptations to work, stress, and physical training.
- 5) Build a scientific foundation for understanding occupational physiology.

DSCC 14 Theory

75 Marks/45 hours

- **Excretory Physiology:** Anatomy of kidney, histological structures of nephron. JG apparatus. Peculiarities of renal circulation and autoregulation. Formation of urine-glomerular and tubular functions, GFR, Tm, tubuloglomerular feedback. Counter current multiplier and counter current exchanger systems. Mechanism of formation of hypertonic urine. Renal regulation of osmolarity and blood volume, acid-base balance. Acidification of urine. Physiology of urinary bladder- micturition. Renal function tests-creatinine, inulin, and urea clearance tests. Non-excretory functions of the kidney. Urine – normal and abnormal constituents. Common diseases of excretory system- glomerulonephritis, UTI, Haemodialysis.

- **Skin and Body Temperature Regulation:** Structure and functions of skin, Cutaneous circulation-peculiarities. Triple response. Sweat glands –structure and types. Sweat –composition, mechanism of formation and regulation of secretion. Sebaceous gland. Composition and function of sebum. Cerumen. Insensible perspiration. Regulation of body temperature in homeotherms - physical and physiological processes, neuro-humoral control. Hyperthermia, hypothermia, and pyrexia.
- **Work Physiology:** Fundamental concepts of work- different categories of work. Physical work, its definition, and nature—isotonic, isometric, isokinetic, positive, and negative work. Static and Dynamic work. Concept of physiological work. Power and capacity relation. Workload – light, moderate (submaximal) and heavy (maximal) depending on intensity and duration of work. Physiological responses to work –cardiovascular, respiratory, metabolic, and muscular – short-term and long-term. Concept of acceptable workload. Study of changes in heart rate, oxygen consumption, and blood pressure to assess a person's ability to withstand work load. Effect of heat stress on physiological responses to work load. Work-rest cycle and importance of rest pause. Muscular fatigue- central and peripheral fatigue in physical work.
- **Fundamentals of Exercise & Sports Physiology:** Exercise, physical activity, and physical fitness. Benefits of exercise Components of fitness and their evaluation. Concept of endurance, strength, and speed in sports activities. Muscle fibre-types and performance. Energetics- concept of work power and energy. Sources of energy. Energy demand for different activities. Nutritional aspects of sports-role of macronutrients and micronutrients in sports performance. Pre-competition diet. Nutritional supplementation. Determination of energy cost by direct and indirect methods. Concept of maximum physical work capacity- factors affecting, methods of measurement by step test, treadmill, and bicycle ergometer. Significance of maximal oxygen consumption ($\text{VO}_2 \text{ max}$) and excess post-exercise oxygen consumption (EPOC), Aerobic and anaerobic capacity. Lactate threshold, lactate tolerance and their usefulness.

DSCC 14 Practical**25 marks/ 30 hours**

1. Determination of Physical fitness by modified Harvard Step Test.
2. Determination of $\text{VO}_2 \text{ max}$ by Queen's College Test.
3. Determination of flexibility and anaerobic power by Sit and reach and Vertical jump test respectively.
4. Determination of hand grip strength and fatigue by hand grip dynamometer.
5. Biochemical identification of normal and abnormal constituents of urine
6. Silver nitrate staining of urinary bladder wall and study of transitional epithelium.

Course Outcome

Upon successful completion of this course, students will be able to:

- 1) Explain the physiological mechanisms underlying urine formation, fluid-electrolyte balance, acid-base regulation, and body temperature homeostasis.
- 2) Interpret renal function tests and correlate abnormalities with common renal disorders.
- 3) Analyze physiological responses to physical work, exercise, heat, and muscular fatigue.
- 4) Evaluate physical fitness, aerobic and anaerobic capacity, work tolerance, and exercise performance using standard physiological assessment methods.
- 5) Apply the principles of exercise, sports, and occupational physiology to optimize physical performance, and prevent work- and exercise-related disorders.

DSCC 15**Microbiology & Immunology**

Total Credit: 4 (Theoretical-3 + Practical-1)

Credit Hours: Theoretical (3x15=45 hrs.) + Practical (2x15=30 hrs.) =75 hrs.

Marks Distribution: Theoretical (75) + Practical (25) = Total 100 marks

Course Objective:

- Students will be able to understand the fundamental concepts of microbiology, including the structure,

classification, and physiological characteristics of microorganisms, viruses and analyze their roles in health, disease, and the environment.

- Students will be able to understand the fundamental principles of the immune system, including its components, mechanisms, and functions in protecting the body against pathogens and maintaining immune homeostasis.

DSCC15 Theory:

75 marks/ 45 hours

- **Microbiology:** Diversity of microbes- basic concept of Whittaker's five kingdom and Carl Woese's three kingdom classification system. Techniques employed for the identification of microorganisms-microscopic, biochemical, and molecular methods. Bacterial classification based on staining techniques -Gram stain and Acid-fast stain and morphological aspects. Bacterial structure, spores, and cysts. Culture of bacteria-nutritional requirements, complex and synthetic media. Physical factors and nutritional requirements for growth. Bacterial growth curve, continuous growth culture. Control of microbial growth- physical and chemical methods used in sterilization, disinfection, and pasteurization. Bacterial metabolism: Fermentation, Glyoxylate cycle and Entner-Doudoroff pathway. Bacterial genetics-transformation, conjugation and transduction, Antibacterial agents - chemotherapeutic agents, antibiotics-definition, mode of action of bactericidal, and bacteriostatic antibiotics. Basis concept of antimicrobial resistance (AMR). Bacterial chemotaxis and quorum sensing. Viral structure-virion, prions and bacteriophages, classification of viruses based on nucleic acid composition and host system, replication of bacteriophages-lytic and lysogenic cycles, Interferons.
- **Immunology:** Overview of innate and acquired immunity. Primary and secondary immune organs. Immune cells-T and B lymphocytes and antigen presenting cells. Structure and functions of- MHC molecules, B-cell receptors, T-cell receptors, cluster of differentiation. Immunogens, and antigens-immunogenicity, haptens, epitopes, paratopes. Adjuvants. Antibody- structure, types, functions, and properties. Antigen-Antibody interactions- association constant, affinity & avidity, neutralisation, precipitation, agglutination, and opsonization. Complement- components, activation pathways, and biological functions. Innate immune responses- phagocytosis, oxidative burst, inflammation. Humoral immune response -plasma and memory cells. Primary and secondary immune responses. T-dependent and T-independent antigens. Cell mediated immune response, T-cell maturation, differentiation –thymic selection. T cell activation. Chemokines and cytokines. Autoimmunity & hypersensitivity- types with examples. Vaccination-Passive and active immunization. Types and uses of vaccines. Toxins and toxoids. HLA - structure, types and transplantation immunology.
- **Parasitology:**

Definition of Parasites. Types-Protozoa, Helminths, and Arthropods. Concept of ecto and endoparasite. Classification of hosts-definitive, intermediate, reservoir, paratenic. Host specificity. Concepts of infection, invasion, pathogenicity, virulence, toxigenicity, carriers and their types. Host-parasite interactions. Hyperparasitism. Parasitoid. Opportunistic and nosocomial infections. Life cycle of *Entamoeba histolytica*, *Plasmodium falciparum*, *Leishmania donovani* –associated diseases and clinical symptoms.

DSCC15 Practical

25 marks/ 30 hours

1. Identification of bacteria using Gram staining method.
2. Microscopic examination of yeast using Lactophenol cotton blue staining.
3. Determination of blood group (ABO & Rh).
4. Pregnancy test by immunological method using synthetic hCG solution.
5. Parasitology: Identification using permanent slides- *Amoeba*, *Entamoeba*, *Paramecium*, *Plasmodium*, *Leishmania donovani*, *Wuchereria bancrofti* and *Ascaris lumbricoides*.
6. Study of the structure of important animal viruses using of electron microphotographs (rhabdo, influenza, hepatitis A/B, SARS COV 2, and retroviruses).

Course Outcome

Upon successful completion of this course, students will be able to:

- 1) Explain the diversity, classification, structure, growth, metabolism, genetics, and laboratory identification of

microorganisms, including bacteria and viruses.

- 2) Apply the principles of microbial culture, sterilization, antimicrobial therapy, and antimicrobial resistance in microbiological and clinical contexts.
- 3) Describe the organization and functions of the innate and adaptive immune systems.
- 4) Interpret antigen-antibody interactions, complement activation, cytokine functions, hypersensitivity, autoimmunity, and transplantation immunology.
- 5) Evaluate the scientific basis of vaccination, immunization, , and the role of immunology in disease prevention and public health.

Semester VII

DSCC 16

Biotechnology, Bioinformatics and Cancer Biology

Total Credit: 4 (Theoretical-4)

Credit Hours: Theoretical (4x15=60 hrs.)

Marks Distribution: Theoretical (100) = Total 100

Learning Objectives:

- 1) Students will be able to understand the fundamental principles and applications of biotechnology and nanobiotechnology, including the use of biological systems and nanomaterials in medicine, agriculture, industry, and environmental management.
- 2) Students will be able to understand the principles and applications of microorganisms in industrial processes, including the production of antibiotics, enzymes, organic acids, alcohol, through microbial fermentation and bioremediation of heavy metals.
- 3) Students will be able to understand the fundamental concepts and tools of bioinformatics, and analyze biological data using computational methods for studying genes, proteins, and molecular interactions.
- 4) Students will be able to understand the fundamental principles of cancer biology, including the molecular and cellular mechanisms of carcinogenesis, tumor progression, and metastasis,

DSCC 16 Theory:

100 marks/60 hours

1. Recombinant DNA technology: Restriction Endonucleases, Ligation, Double Digest, Modification of Restriction Fragments ends.

2. Amplification of DNA and cloning: PCR and Cell based DNA Cloning – The importance of DNA Cloning,. PCR – steps and application. Principles of Cell-based DNA Cloning. Cloning vectors- Plasmid vectors, Expression vectors, Super vectors (YACs and BACs).

3. Nucleic hybridization: Principle and application - Preparation of nucleic probes, Principle of Nucleic acid hybridization, Basic concept of microarray.

4. Nanobiotechnology: DNA nanotechnology - self-assembled DNA nanotubes and their applications. Nanoparticles for physiological assays. Nanoparticles for drug delivery vehicles - surface modification of nanoparticulate drug carriers. Overview of the nanotechnology in patient diagnostics. Biosensors-classification and applications. Nanotechnology in tissue engineering. Gross toxicological effects of nanomaterials-pathophysiological and biochemical effects and ethical issues.

4. Industrial Biotechnology: Antibiotic fermentations – production of penicillin, semi-synthetic streptomycin, Erythromycin. Recombinant and synthetic vaccines-problems with traditional vaccines, impact of Biotechnology on vaccine development-Subunit vaccine for Hepatitis B, potential problem of subunit vaccines). Microbial production of Vitamins (B12, riboflavin A) and enzymes. Bioremediation of heavy metals- Basic mechanisms.

4. Bioinformatics: Protein primary sequence analysis, DNA sequence analysis, pair wise sequence alignment, FASTA algorithm, BLAST, multiple sequence alignment, DATA base searching using BLAST and FASTA.

5. Cancer Biology: Cell Cycle – checkpoints. CDKs. Basic concept of apoptosis. Tumor- benign and malignant. Properties of Cancer cells. Types of cancer. Oncogenes and oncoviruses. Tumor Suppressors. Applications of chemotherapy, radiotherapy, immunotherapy in cancer treatments.

Course Outcome:

After completing this module, students will be able to

- 1) Describe the fundamental principles and tools of biotechnology, including genetic engineering and recombinant DNA technology, explain the basic concepts and techniques of nanobiotechnology and the properties of nanomaterials used in biological systems, analyze the applications of biotechnology and nanobiotechnology in medicine, agriculture, industry, and environmental management and evaluate the potential benefits, limitations, and ethical considerations associated with modern biotechnological and nanobiotechnological advancements.
- 2) Describe the role of microorganisms in industrial processes and their importance in biotechnology and manufacturing, explain the principles of microbial fermentation and bioprocess technology used in industrial production, analyze the production of commercially important microbial products, such as antibiotics, enzymes, organic acids, and alcohol and evaluate the applications of industrial microbiology in pharmaceutical, food, and environmental industries.
- 3) Describe the basic principles and scope of bioinformatics in modern biological research explain the use of biological databases and bioinformatics tools for storing, retrieving, and analyzing genetic and protein data, analyze biological sequences using computational methods, including sequence alignment and gene identification and interpret bioinformatics data for applications in genomics, proteomics, and molecular biology research.
- 4) Describe the fundamental concepts of cancer and carcinogenesis, explain the roles of oncogenes, tumor suppressor genes, and genetic mutations in the development of cancer, analyze the mechanisms of tumor growth, invasion, and metastasis and evaluate the principles of cancer prevention, diagnosis, and therapeutic strategies used in cancer management.

DSCC 17 **Pharmacology, Toxicology & Stress Physiology**

Total Credit: 4 (Theoretical-4)

Credit Hours: Theoretical (4x15=60 hrs.)

Marks Distribution: Theoretical (100) = Total 100

Learning Objectives:

This course is designed to:

- 1) Provide a comprehensive understanding of the principles of pharmacology, toxicology, forensic biology, and stress physiology.
- 2) Develop knowledge of drug action, pharmacokinetics, and pharmacodynamics,
- 3) Introduce the mechanisms of toxicity, oxidative stress, and cellular defence systems.
- 4) Familiarize students with the principles and applications of forensic biological techniques
- 5) Build an integrated understanding of physiological responses to drugs, toxic agents, and stress in health and disease.

DSCC 17 THEORY

100 mark/60 hours

- **Fundamentals of Pharmacology:** Definition of drug by WHO. Nomenclature. Prescription and non-prescription drugs. Routes of drug administration. *Pharmacokinetics*- drug absorption distribution

metabolism and excretion (ADME) Concept of bioavailability, volume of distribution, biotransformation (Phase I and Phase II), first -pass metabolism, clearance. and plasma half-life. Loading and maintenance dose of drug. *Pharmacodynamics*: drug- receptor interaction, mechanism of action of drugs, adverse reaction of drugs, agonists, partial agonists, inverse agonists, antagonists, dose-response curves, efficacy and potency, therapeutic index. ED50. LD50.

- **Systemic Pharmacology:** Therapeutic uses, mechanism of action of drugs acting on physiological systems. *Analgesics and antipyretic*: (morphine diclofenac, paracetamol). *Anti-inflammatory (NSAIDs - aspirin)*, *Gastrointestinal*: Antacids-(magnesium hydroxide), H2-Blockers-(ranitidine), Proton Pump Inhibitors- (rabeprazole), *Cardiovascular*: Anti-anginal (Isosorbide), blood thinner (warfarin), thrombolytic- (Heparins), anti-hypertensives. (amlodipine) *Respiratory*: bronchodilators- (Salbutamol, Budesonide), *Central Nervous system*: sedatives and hypnotics (benzodiazepines, Zolpidem), *Anesthetics*: General – (Ketamine, Thiopental Sodium) and local (xylocaine), anti-epileptic (Valproate), anti-psychotic (Chlorpromazine), *Autonomic Nervous System*- Sympathomimetic (Norepinephrine), alpha adrenergic blockers- (Prazosin), beta adrenergic blockers- (Propranolol), cholinomimetic-(methacholine), anti-cholinergic (atropine). *Kidney* – diuretics (furosemide), *Endocrine* – antidiabetic (metformin).
- **Fundamentals of Toxicology:** Definition and classification of toxic agents, environmental toxicants (heavy metals, pesticides, food additives), contaminants (organic, inorganic, and radioactive). Routes of exposure to toxicants and factors influencing toxicity. Systemic and organ toxicity (hepatotoxicity, neurotoxicity, and nephrotoxicity). Endocrine disruptors-xenoestrogen. Source and toxic effects of cadmium, lead, mercury, arsenic, organochlorides, organophosphates, microplastics, metanil yellow, rhodamine-B, PCDD, PAH, PCB and BPA.
- **Forensic Biology:** Definition and scope. Types of biological samples. DNA fingerprinting- principle, methods, and application. Paternity testing. Polygraph test.
- **Stress physiology:** Definition & types of Stress and Stressors. General Adaptation syndrome. Role of Hypothalamic-Pituitary-Adrenal (HPA) axis and Sympatho-Adrenal Medullary (SAM) axis in stress response. Systemic effect of stress on cardio-respiratory, musculoskeletal, immune, metabolic, and endocrine systems. Oxidative stress. Formation of Reactive oxygen Species (ROS), Reactive Nitrogen Species (RNS). Oxidative damage and Lipid peroxidation. Role of antioxidant enzymes-catalase, superoxide dismutase, glutathione, peroxidase, glutathione reductase, thioredoxylperoxidase, and peroxiredoxin in coping stress. Redox homeostasis. Non-enzymatic antioxidants- glutathione, Vitamin C, vitamin E and melatonin. Cellular stress response against reactive oxygen and nitrogen species.

■ **Course Outcome:**

After completing this course, students will be able to:

- 1) Explain fundamental principles of pharmacology, pharmacokinetics, and pharmacodynamics.
- 2) Describe mechanisms, therapeutic uses, and adverse effects of major drugs acting on physiological systems.
- 3) Interpret concepts of toxicology, sources of environmental toxicants, and mechanisms of systemic toxicity.
- 4) Understand applications of forensic biology, including DNA fingerprinting and biological evidence analysis.
- 5) Explain physiological mechanisms of stress and oxidative stress, including hormonal responses and antioxidant defense systems.

DSCC 18

Advanced Sports Physiology, Ergonomics, & Physiology in Space

Total Credit: 4 (Theoretical-4)

Credit Hours: Theoretical (4x15=60 hrs.)

Marks Distribution: Theoretical (100) = Total 100

Learning Objectives:

This course is designed to:

- 1) Provide advanced knowledge of exercise physiology, sports science, and yoga.
- 2) Familiarize students with the physiological basis of human performance in extreme environments.
- 3) Develop an understanding of physiological adaptations in aviation, and spaceflight.
- 4) Introduce scientific methods for assessing physical fitness, body composition, and ergonomic risks.
- 5) Promote the application of physiological principles to optimize occupational well-being.

■ **Advanced Exercise & Sports Physiology**

Training principles for different sports activities. Principles and their impact on performance level in sports with reference to cardiovascular, respiratory, and muscular changes. Overtraining and detraining and their physiological effects. Warm up and cool down. Physical fitness and its assessment by Harvard and modified Harvard Step Tests. Muscular fitness and its assessment. Methodologies for the analysis of body composition. Somatotyping and its role in selection of sports activity. Ergogenic aids and ergolytic agents. Doping- dope substances and drug abuse in sports. Blood doping.

■ ***Yoga and its impact on Health:***

History and classification of yoga. Effects of asanas on muscle flexibility, proprioception, and posture. Brain plasticity and neurocognitive benefits of meditation. Effects of pranayama on lung function and oxygen consumption. Therapeutic yoga for lifestyle and chronic disorders like, arthritis, neurodegenerative diseases, obesity, and asthma.

■ ***Industrial Ergonomics***

Definition of industrial productivity and role of ergonomics in improving productivity. Ergonomic principles of safe load handling; evaluation of working posture using OWAS, REBA and RULA methods; Ergonomics in risk assessment, mitigation and hazard control; industrial accidents and safety; Industrial temperature assessment and thermal comfort, heat stress index and effect of extreme heat on worker performance; Illumination – assessment of illumination level and its effect on work performance; industrial noise – assessment of industrial noise and its effect on work performance; Noise Induced Hearing Loss – definition, assessment and non-auditory effects of noise; vibration – definition, assessment of hand-arm and whole-body vibration and its effects on the human body.

■ ***Occupational Health***

Introduction to Occupational Health-definition, scope, and importance. Workplace Stress and Mental Health. Introduction to OSHA and ISO Standards. Use of personal protective device (PPD) against the work-related hazards -PPD in thermal protection, face and eye protection, noise protection, and respiratory protection. Ionizing and non-ionizing radiation. Definition and assessment in the work environment Threshold Limit Value and Permissible Exposure Limit of Hazards.

■ ***Aviation and Space Physiology***

Physical and physiological zones of the atmosphere. Effect of linear acceleratory and deceleratory forces on body. Concept of effective performance time (EPT) and time of useful consciousness (TUC) in various altitudes. Altitude induced decompression sickness.

Historical perspectives and milestones in Space Physiology. Study of parameters related to space flight-acceleration, deceleration, weightlessness, thermal extremes, and G-forces. Physiological effect of positive and negative g-forces. Physiological effects of cosmic radiation. Effects of microgravity on cardiovascular, digestive, musculoskeletal, and neuro-vestibular systems. Spatial disorientation.

Course Outcomes (CO)

Upon successful completion of this course, students will be able to:

- 1) *Explain the physiological principles underlying exercise training, sports performance, physical fitness, and athletic conditioning.*
- 2) *Evaluate the effects of yoga, meditation, and pranayama on physical, respiratory, neurological, and mental health.*
- 3) *Apply ergonomic principles and occupational health standards to assess workplace hazards, improve productivity, and prevent work-related injuries and disorders.*
- 4) *Analyze the physiological responses to aviation, spaceflight, microgravity, and other extreme environmental conditions.*

DSCC-19
(Practical Only)

Total credit – 04

Total marks: 100

1. Estimation of postural stress among college student using RULA (from photographs)
2. Recording of heart rate and blood pressure during static and dynamic work
3. Assessment of prevalence of musculoskeletal disorder by questionnaire method.

4. Kymographic recording of the intestinal movements of rats in Dale's bath and effects of hypoxia and graded doses of adrenaline and acetylcholine on the movement
5. Hematoxylin Eosin staining of permanent tissue sections: Liver, Kidney, Small intestine, Lung.

DSCC-20
(Practical Only)

Total credit – 04

Total marks: 100

1. Preparation of Amphibian Ringer Solution and kymographic recordings of the movements of perfused heart of toad and the effects of excess K^+ and Ca^{++} ions, graded doses of acetylcholine and adrenaline on the contraction of heart.
2. Permanent tissue preparation: Fixation, Dehydration, Clearing, Embedding, Section cutting.
3. Histochemical identification of glycogen by Periodic acid-Schiff stain and counter stain with hematoxylin: Liver and thyroid.
4. Iron hematoxylin staining of cross striations in skeletal muscle / myelin sheath in nerve fibre (fresh tissue).
5. Determination of workload from heart rate and cardiac indices and classification of work load by step test.

Semester VIII

RM-1
Research Methodology-I

(For both Honours & Honours with Research Course)

Total Credit: 4 (Theoretical-3, Viva-1)

Credit Hours: Theoretical (3x15=45; Viva (1x 15) =60hrs.)

Marks Distribution: Theoretical (75) + Viva (25) = Total 100

Learning Objectives:

This course is designed to:

1. Introduce the fundamental principles, and methodologies, of biomedical and physiological research.
2. Develop skills in literature review, research design, and scientific data collection,
3. Familiarize students with biomedical research ethics, scientific integrity, and responsible conduct of research.
4. Build competence in scientific writing, research proposal development, publication, presentation, and scholarly communication.
5. Provide foundational knowledge of intellectual property rights, patenting, technology transfer, and research translation from laboratory to industry.

RM-1

THEORY

100 mark/60 hours

- **Fundamental concepts of Research:** Types of research- Basic, research, applied research, quantitative and qualitative research, epidemiological, clinical, translational, implementation research, in-silico research. Fundamental steps of research - identification of research problem, literature review (search scientific journals, databases -PubMed, Scopus, Web of science, JSTOR and books), identify research gap, formulating research question or hypothesis, determining appropriate research design and methodology, develop work plan for data collection & data analysis, consideration of ethical issues, make a budget plan, conveying research outcome (publication or conference presentation).
- **Research Study Designs-** Pilot study, Qualitative and Quantitative (case report, case series, case-control, cross sectional, cohort-prospective and retrospective, randomized controlled trials). Clinical trials -phases. Study types – observational and experimental. Mixed method designs. Survey and Field study. Strength and weaknesses of common study designs.

- **Literature Review:** Types of research articles- primary & secondary. Types of reviews (literature review, systematic review, meta-analysis). Steps of literature review (framing research question, search relevant sources and databases-key word search, search engines- use of Google scholar, Semantic scholar, PubMed, ScienceDirect, Scopus, Web of Science, *Sodhganga* /INFLIBNET, National Digital Library of India).
- **Methods of Data collection:** Categories of data- primary and secondary. Primary data collection techniques-questionnaire, interview, observation, anthropometric measurements, clinical examinations, and laboratory investigations. Questionnaire -types, structured, semi-structured, close and open-ended, dichotomous and multiple choice. Rating scales-Likert scale and Hedonic scale. Designing of questionnaire. Secondary data (Govt. publication, reports, NFHS data in public domain, Hospital registers).
- **Ethics in Research:** Basic principles for biomedical research ethics. Informed consent process. Confidentiality and privacy. Ethical guidelines for biomedical research (WMA declaration of Helsinki, 1964 and ICMR ethical guidelines). Animal ethics committee. Institutional ethics committee on human subject.
- **Citation and Referencing Style:** Importances of references. Citation and referencing styles with examples- APA, Vancouver, AMA, Harvard. Difference between reference and bibliography. Reference citation tools-open ware (Mendeley, Zotero) and subscription based (Endnote). Ethical guidelines for publishing research. Plagiarism detection tools (Turnitin, iThenticate).
- **Scientific Communication & publication:** Component of a research proposal for grant (title, introduction, aims and objectives, review of literature, materials and methods, data collection, ethics approval, budget, proposal summary, and references). Steps of research publication- Journal selection and Impact factor, manuscript (title, authorship criteria, abstract, key words, introduction, methods, results, & analysis, discussion, acknowledgement, tables and figures, and references). Plagiarism check, submission and following journal response. Peer review and types. Citation metrics. Basic structure of scientific power-point presentation.
- **Laboratory to Industry:** Definition of IP and types. Intellectual property rights (IPR) and its importance. IPR. Agencies responsible for IP registration. Copyright definition, importance, originality of material, Indian copyright act. Patent-definition, types of patents, Basic criteria for patentability. Patent Commercialization (Licensing, technology transfer, startups). Indian Patent Act, 1970.

Course outcome:

- 1) Explain different research study designs and evaluate their strengths and limitations in biomedical investigations.
- 2) Conduct systematic literature searches and reviews using scientific databases and research resources.
- 3) Apply appropriate data collection methods including questionnaires, interviews, surveys, and clinical measurements.
- 4) Demonstrate ethical responsibility in research, including informed consent, confidentiality, and institutional guidelines.
- 5) Develop scientific communication skills, including citation, manuscript preparation, research presentation, and understanding intellectual property rights.

RM-2

Research Methodology-2

(For both Honours & Honours with Research Course)

Total Credit: 4 (Theoretical-3, Viva-1)

Credit Hours: Theoretical (3x15=45; Viva (1x 15) =60hrs.)

Marks Distribution: Theoretical (75) + Viva (25) = Total 100

Course Objectives:

- 1) Students will be able to understand the historical development of physiology through the contributions of

eminent academicians and scientists, and analyze how their discoveries have shaped modern concepts and advancements in physiological sciences.

- 2) Students will be able to understand the fundamental experimental and analytical methods used in physiological research, and explain the principles and applications of common laboratory techniques used to study physiological functions.
- 3) Students will be able to understand the basic principles of probability and statistical analysis, and apply statistical significance tests to analyze and interpret biological and physiological data.

RM-2

Theory

100 marks/60 hours

1. Contributions of Academicians and Scientists in Physiology: Claudius Galenus, Charaka, Claude Bernard, Jean François Fernel, Santiago Ramón y Cajal, Professor Subodh Chandra Mahalanobis, Professor Narendra Mohan Basu, Professor Sacchidananda Banerjee, Professor A.S. Paintal, Professor Sukhamay Lahiri, Dr. Dilip Mahalanobis. Nobel Prize in Physiology or medicine.

2. Biophysical method: Principles, applications, advantages, and disadvantages of recording of peripheral nerve conduction velocity, Gas Chromatography, Mass Spectroscopy, FT-IR, XPS, Raman Spectroscopy, Comet assay, Radioactive tracers, Immunophenotyping.

3. Principle of instruments associated with bio-medical research: CTScan, MRI, Artificial heart-lung machine, Holter monitor, USG, Endoscopy, Dialyzer, Fluorescence probe techniques, Artificial pacemaker EEG, ECoG,

4. Molecular Biology Techniques: Principles, methods, advantages and disadvantages of RT-PCR, qPCR, RFLP, Comet assay and Tunnel assay, Isolation of genomic DNA, 18S and 16S rRNA Sequencing, Protein Misfolding Cyclic Amplification, Thioflavin T assay.

5. In vitro Cell Culture techniques: *Cell line used:* Primary, secondary, finite cell lines and continuous cell lines. *Types of cultures.* *Techniques:* Aseptic transfer, passaging, cell viability counting and media change. Applications and limitations.

6. Animal models used in research: Concept of animal house. Ethical aspects. Animal models in Physiological Research: types, selection criteria, basic handling techniques for rat, mice and zebra fish. Animal labelling techniques, Induction of diseases in animals (surgical and chemical). Transgenic animals. Behavioral studies (Maze studies for memory and open field studies for anxiety). Sample collection: root of blood collection, organ collection techniques, histopathological staining techniques (haematoxylin eosin, PAS and immunohistochemistry).

7. Statistical Analysis in Biology: *Probability distribution*-Probability, Probability distributions, Normal distribution, Skewness, Kurtosis, Confidence interval, Binomial distribution, Poisson distribution. *Testing hypothesis*-Null & alternative hypothesis, degree of freedom. Levels of significance, Errors of interference, One-tail and two-tail tests, t-tests for significance of difference between means, Product moment correlation and Simple linear regression. *Nonparametric statistics*-Chi square test of independence, Chi square test for goodness of fit. One-way Anova.

Course Outcome:

After completing this module, students will be able to

- 1) Describe the major contributions of eminent academicians and scientists to the development of physiological sciences, explain the historical evolution of important physiological concepts and discoveries, analyze the impact of landmark experiments and scientific findings on modern physiology and appreciate the role of scientific research and innovation in advancing knowledge in physiology.
- 2) Describe the basic experimental techniques and instruments used in physiological studies, explain the principles and applications of common physiological laboratory methods used to study body functions, analyze physiological data obtained from experiments and interpret the results and apply appropriate experimental approaches for investigating physiological processes in research and laboratory settings.
- 3) Describe the fundamental concepts of probability and statistical distributions used in biological research, explain the principles of hypothesis testing and statistical significance in the analysis of experimental data, apply common statistical tests (such as t-test and chi-square test) to analyze physiological and biological data

and interpret statistical results and draw meaningful conclusions from experimental observations.

DSCC 21

Evolution and Comparative Physiology (Only for Honours without Research Course)

Total Credit: 4 (Theoretical-4)

Credit Hours: Theoretical (4x15=60 hrs.)

Marks Distribution: Theoretical (100) = Total 100

Learning Objectives:

This course is designed to:

- 1) Provide a comprehensive understanding of human evolution, comparative physiology, and the evolutionary basis of physiological adaptations.
- 2) Develop knowledge of neonatal development, and physiological changes across the human lifespan.
- 3) Introduce comparative physiological mechanisms that enable vertebrates to adapt to diverse environmental challenges.
- 4) Familiarize students with the cellular, molecular, and physiological basis of aging.

DSCC 21 THEORY

100 mark/60 hours

- **Overview of Evolutionary concept and Human Evolution:** Definition and significance of evolution. Overview of evolutionary theories: Lamarckism, Darwinism, and their limitations. Modern synthetic theory of evolution. Speciation: types and examples. Primates and Human Ancestry. Characteristics of living primates. Evidence of Human Evolution- paleontological and radiocarbon dating. Key hominin fossils- Australopithecus, Homo habilis, Homo erectus, and Neanderthals. Major transitions in hominin evolution- bipedalism, evolution of brain size and skeletal adaptations. Early human migration and factors driving. Origin of homo sapiens and comparison (anatomical and cognitive) with early humans. Ancient hominin extinction-key factors. Molecular markers of evolution- mitochondrial DNA and Y-chromosome.
- **Comparative Physiology:** Concept of functional diversity of animals in response to environmental and evolutionary pressure. Comparative physiology in vertebrates: evolution of heart, respiratory organs, nitrogen catabolism (ammoniotelic, ureotelic, uricotelic), osmoregulation (stenohaline, euryhaline, osmoconformers, osmoregulators), body temperature regulation (endothermy, ectothermy and heterothermy), and reproductive modes (oviparity, viviparity and ovoviviparity).
- **Geriatric Physiology:** Definition of aging, Age related changes in physiological system- cardiovascular, pulmonary, musculoskeletal, urological, endocrine, and neurological. Cellular and molecular mechanism of aging -DNA damage, telomere shortening, mitochondrial dysfunction and epigenetic changes. Cellular senescence. Age-related disorders- Hypertension, senile dementia, Alzheimer's disease, COPD, osteoarthritis, osteoporosis, cataract and hearing loss.
- **Neonatal Physiology:** Definition and period involved. Understanding of term, pre-term, and post-term baby. APGAR score and its components. Physiological changes at birth- changes in circulation, surfactant and respiratory adaptation, foetal hemoglobin and its oxygen affinity, myelination, primitive reflexes, thermoregulation in newborns. Brown fat. Breast feeding and colostrum. Neonatal jaundice. Respiratory distress syndrome (RDS). Growth spurt – definition. Linear growth, and bone maturation. Endocrine regulation of growth.
- **Mental Health:** WHO definition of mental health. Neurobiology of mental health and well-being- role of neurotransmitters. Basic idea of common mental health disorders and their management– anxiety disorders, depression, schizophrenia, bipolar disorder, neurodevelopmental disorders (ADHD and ASD).

Course Outcome:

- After completing this course, students will be able to:
- Explain major evolutionary theories and evidence of human evolution,
- Describe comparative physiological adaptations in vertebrates,
- Understand physiological mechanisms of aging and their association with common geriatric disorders.
- Explain physiological adaptations in the neonatal period,
- Explore basic neurobiological mechanisms of mental health and recognize common mental health disorders.

DSCC 22

Ecology and Population Biology
(Only for Honours without Research Course)

Total Credit: 4 (Theoretical-4)

Credit Hours: Theoretical (4x15=60 hrs.)

Marks Distribution: Theoretical (100) = Total 100

Learning Objectives (LO)

This course is designed to:

1. Provide a comprehensive understanding of ecological principles, dynamics and population biology.
2. Develop knowledge of population genetics, gene frequency, and the Hardy–Weinberg principle in biological populations.
3. Introduce the ecological consequences of anthropogenic activities, climate change, pollution, biodiversity loss, and conservation strategies.
4. Familiarize students with animal communication, behavioural ecology, and adaptive responses to environmental challenges.

DSCC 22 THEORY**100 mark/60 hours**

- **Basics of Ecology and Population biology:** Definition of ecology and ecosystem. Levels of organizations in ecology and hierarchy. Laws of limiting factors- Blackman's law and Shelford's law. Community structure and energy flow in ecosystems. Biogeochemical cycles- carbon, nitrogen, and water cycles. Overview of population growth models- exponential and logistic. Population dynamics- age structure, sex ratio. Key demographic statistics of India.
- **Gene frequency in a Population:** Factors influencing gene frequency. Hardy-Weinberg Principle: Calculation of gene frequency and genotype frequency (for autosomal gene only)
- **Anthropogenic activities and Environmental concerns:** Anthropocene era. Anthropogenic activities- definition, examples, impacts on ecosystem. Anthropogenic climate change. Anthropogenic sources of greenhouse gases. Global warming. Anthropogenic pressure- causes and consequences. Impact of anthropogenic pressure on biodiversity loss and species extinction. Biodiversity loss in India. Human-wildlife conflict. Key conservation strategies: in-situ and ex-situ conservations. Role of indigenous communities in biodiversity conservation. Concept of exotic or invasive Species and their impact on ecosystem. Human migration – types and causes. Challenges related to human migration in India,
- **Anthropogenic pollution and its impact on Ecosystem:** Definition of pollution and pollutants. Types of Pollutants with examples. Anthropogenic causes of air and water pollution. Effects of air and water pollution on environment - acid rain, photochemical smog, ozone layer depletion, eutrophication; bioconcentration and biomagnification. Plastic pollution-sources and impacts. Radioactive pollution- sources, impacts on human health and environment.
- **Animal Communication and Behavioral Ecology:** Communication in animals-- visual, olfactory, auditory. and tactile. Hormones in behaviour -pheromones and kairomones. Ecological Aspects of animal behaviour- habitat selection, food selection and optimal foraging theory, anti-predator defences, aggression, territoriality, dispersal, and migration. Parental care. Navigation – key mechanisms in animals. Neural circuit for spatial navigation.

Course Outcome:

After completing this course, students will be able to:

- 1) Explain fundamental ecological concepts, structure, energy flow, and biogeochemical cycles.
- 2) Interpret population growth models and demographic parameters relevant to population dynamics.
- 3) Assess impacts of anthropogenic activities on climate change, and biodiversity
- 4) Evaluate ecological consequences of environmental pollution.
- 5) Describe mechanisms of animal communication and behavioural ecology.

(Only for Honours without Research Course)**Review work**

1. **Review work.** Full marks -100

Credit=4 (Theory-3; Viva-1)

Marks distribution: (Report submission-50, Presentation-25, and Viva-25)

Specifications:

- a. Review report to be duly forwarded by respective Guide/Teacher.
- b. Total number of pages: maximum 35-40 pages.
- c. Size of paper: A4
- d. Space: 1.5-2.0/. Font 12, Heading 14 (Bold), Times New Roman
- e. The Review Report is to be evaluated by a common panel of External Examiners.

(For Honours with Research Course)**Research Internship.**

1. **Research Internship.** Full marks -100

Credit=4 (Theory-3, Viva-voce-1)

Marks distribution: (Internship Report-50, Presentation-25, and Viva-25)

Specifications:

1. As per CU norms.
2. From Industry/ Research Institute/ Home centre.
3. Submission of Internship Report- (duly forwarded by concerned authority).
4. Format Style as in Indian Journal of Experimental Biology Published by National Institute of Science Communication and Information Resources.
5. Page no -max 35-40.

Dissertation/ Project

Total marks-200

Credit- 8 (6 Theory + 2 Viva)

1. **Review Work:**

Full marks -100. Marks distribution: (Report submission-50, Presentation-25, and Viva-25)

Specifications:

- a. Review report to be duly forwarded by respective Guide/Teacher.
- b. Total number of pages: maximum 35-40 pages.
- c. Size of paper: A4
- d. Space: 1.5-2.0/. Font 12, Heading 14 (Bold), Times New Roman
- e. The Review Report is to be evaluated by a common panel of External Examiners.

2. **Project:**

Full marks 100; Marks distribution: (Report-50 + Presentation-25 + Viva 25)

The Project Report for UG 8th Semester Examination (Honours with Research) in Physiology is to be submitted in the following format:

1. Title page (duly signed by candidate and supervisor)
2. Content with page number
3. List of abbreviations
4. Abstract
5. Introduction
6. Review of Literature
7. Aims and Objectives
8. Methods and Materials
9. Results
10. Discussion
11. Summary and Conclusion
12. References
 - a) Cited by first author and year of publication in the text and arranged alphabetically in the list of references.
 - b) Cited numerically in the text and arranged serially in the list of references.
 - c) Style-as per Indian Journal of Experimental Biology (IJEB)
13. Acknowledgement (if any).

Other specification:

- a. Total number of pages: 35-40 pages
- b. Size of paper: A4 Bond
- c. Space: 1.5-2.0/ Font 12, Heading 14 (Bold), Times New Roman
- d. Length: 10,000 words
- e. Number of copies to be submitted

The Review and Project Report are to be evaluated by a common panel of External Examiners.

DETAILED SYLLABUS

**PHYSIOLOGY MDC & MINOR
SEMESTER-I**

PAPER: MDC CC-I/ MN-1/ MDC-Mn-1

(Introductory Physiology: Human Body Organisation, Body Fluids and Biophysics)

Total credit – 04

Total marks: 100

MDC CC1 Theory (3 Credits, 75 Marks)

- **Cell and Tissues:** Electron microscopic structure and functions of eukaryotic nucleus, mitochondria, Golgi apparatus, endoplasmic reticulum, ribosome, lysosomes, peroxisomes, cytoskeletal proteins, and centriole. Plasma membrane. Membrane transport- simple diffusion, osmosis, ion channels, ionophores. Carrier-mediated transport- uniport, symport and antiport, Passive and Active transport. Types, structure, general characters, distribution, and functions of epithelial, connective, muscular, and nervous tissue.
- **Cell cycle and Genetics:** Basic concepts of Mendelian Genetics. Laws of inheritance. Chromosome: structure and classification, Chromosomal DNA packaging-nucleosomes. Euchromatin and heterochromatin. Human genome and its characteristics (basic concept). Cell cycle- events. Cell division- Mitosis & Meiosis phases and significance. Crossing over, linkage.
- **Blood and body fluid:** Concept of body fluid compartments. Composition and function of blood and lymph, Plasma and Serum. Plasma protein-components and their functions. Plasmapheresis. Structure and functions of formed elements. Erythropoiesis-factors regulating. Haemoglobin-structure, compounds and derivatives, normal variants- embryonic, fetal, and adult haemoglobins. Hemostasis. Blood coagulation-factors and pathways. Procoagulants and anticoagulants. Fibrinolysis.

. MDC CC1 PRACTICAL (1 credit, 25 marks)

1. Fresh tissue experiments- (a) Staining of squamous epithelial cells with methylene blue, (b) Staining of Adipose tissue with Sudan III or IV
2. Preparation and staining of blood film with Leishman's stain and identification of formed elements of blood.
3. Estimation of total hemoglobin by Drabkin's method.
4. Problems on Mendelian inheritance. Haemophilia/Blood Group.
5. Identification of anatomical planes and muscles from photographs. Anatomical planes-sagittal, frontal (Coronal), transverse (Horizontal). Muscles- masseter, deltoid, biceps brachii, triceps brachii, biceps femoris, gastrocnemius and soleus.

Course outcome:

After completion of this course, students will be able to:

1. Describe the ultrastructure and functions of eukaryotic cells, cellular organelles, plasma membrane, membrane transport mechanisms, and the organization of different types of human tissues.
3. Describe the composition and physiological functions of body fluid compartments, blood, lymph, plasma proteins, formed elements of blood, hemoglobin, and the processes of erythropoiesis and hemostasis.
4. Explain the mechanisms of blood coagulation, anticoagulation, fibrinolysis, and the physiological significance of plasma proteins and hemoglobin variants.
6. Apply the principles of Mendelian inheritance to solve genetic problems involving blood groups and sex-linked inheritance, including haemophilia.
7. Identify major anatomical planes and selected skeletal muscles from photographs and relate their anatomical features to physiological functions.

PAPER: IDC

(Elementary Physiology)

Total credit – 03

Total marks: 75

IDC Theory (2 Credits, 50 Marks)

- **Outlines of Human Body:** 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, Intestines, Kidney, Sense organs, Reproductive organs.
- **Applications of Biophysical principles in Physiology:** Importance of major biophysical parameters in Physiology: Diffusion, Osmosis, Enzyme. Macro and Micronutrients and biomolecules involved in maintenance of human health: Definition & classifications with examples and functions of Carbohydrate, Protein, Lipids, Vitamins.
- **Blood:** Composition and functions of blood; functions of different blood cells. Composition and functions of Plasma proteins, hemoglobin molecule and anaemia.
- **Hormones:** Definition of hormone. Major secreting hormones and their important functions: Pituitary, Adrenal, Thyroid and Pancreas. Primary concept on Nerve fibers, Synapses, reflex action.
- **Applications of physiological principles in human welfare:** Basic concepts of Ergonomics and its importance in occupational health. Sports and Exercise Physiology: Physical fitness. Classification of

sports, Basic concept of anthropometry. Haematology: 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. Definitions of Antigen and Antibody and Antibiotic and Vaccine with examples. Biotechnology: outline concept and its modern applications. First Aid-definition. Wounds-types, CPR. First aid in drowning and poisoning- snake bite, insect bites, and sting.

- **Community health:** Prevailing global communicable and non-communicable diseases, their primary causes and suggested measures: Influenza, Tuberculosis, Hepatitis, COVID-19, Diabetes mellitus, Haemophilia, Thalassemia, COPD, Malaria, Dengue. Obesity, Pathophysiological tests, their normal range in the system and indicative diseases: TC, DC, ESR. Fasting and Postprandial blood sugar tests, Glycosylated haemoglobin, Bilirubin SGOT, SGPT, Uric acid, Creatinine.

IDC Practical: (1 credit: 25 marks)

1. Determination of pulse 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 (WHO classification for Asians), waist-hip ratio of human subject.
4. Determination of Blood group.

Course outcome:

On completion of this course, students will be able to:

1. Explain the organization of the human body, the structure and functions of cells, tissues, and major organ systems, and their roles in maintaining physiological homeostasis.
2. Describe the importance of fundamental biophysical principles, biomolecules, macro- and micronutrients, and enzymes in normal physiological functions and human health.
3. Describe the composition and functions of blood, plasma proteins, hemoglobin, hormones, nervous tissue, and their physiological significance.
4. Describe the physiological basis of ergonomics, physical fitness, blood grouping, microbiology, immunology, biotechnology, first aid, and public health applications.
5. Explain the causes, prevention, diagnosis, and physiological basis of common communicable and non-communicable diseases, including the interpretation of basic clinical laboratory investigations.
6. Demonstrate practical skills in measuring pulse rate, arterial blood pressure, body mass index (BMI), waist-hip ratio, and determination of ABO and Rh blood groups using standard procedures.

PAPER: MDC-SEC

Clinical haematology, Therapeutic nutrition, public hygiene, Basic Lab. Techniques and Food adulterants

Total credit – 04

Total marks: 100

MDC SEC Theory (2 Credits, 50 Marks)

- **Clinical Haematology and Haematological Techniques:** Concept of complete hemogram. Definition, normal values, and clinical significance of total count of RBC, WBC, platelets, differential count of WBC, PCV, MCV, MCH, MCHC, ESR, bleeding time, clotting time. Anemia- classification, diagnostic criteria and management. Glycated haemoglobin. Blood grouping- ABO and Rh. Bombay Blood group. Concept of Blood bank. Blood donation criteria. Blood transfusion-, indication, precaution, and hazards. Erythroblastosis fetalis. Haematological disorders-polycythemia, leukocytosis, leukopenia, leukaemia, thrombocytopenia, and purpura, haemophilia. Hemoglobinopathies- Sickle-cell anaemia and Thalassemia.

- **Therapeutic Nutrition:** Assessment of nutritional status by anthropometry -weight for age, height for age, weight for height, head circumference, chest circumference, mid upper arm circumference, Body mass index, Ponderal index Waist hip ratio. Nutritional requirement and dietary formulation for children, adolescent and geriatric population. Basic concepts of diet therapy. Classification of therapeutic diets based on nutrient restriction/ modification, texture of food. Nutritional concern and dietary management of obesity, diabetes, hypertension, and nutritional anaemias.
- **Public Hygiene and First Aid:** Awareness about food and water safety. Sources and potability of water. Water and food borne infections. Causative factors, symptoms, mode of transmission and methods of prevention of Hepatitis A, rotavirus diarrhoea, bacillary dysentery, cholera, amoebiasis, botulism, salmonellosis, shigellosis. Hygiene – Definition; Personal, Community, Medical and Culinary hygiene. Ideal hand washing method. Microbial Standards for Foods and Water. Waste and sewage disposal.

First Aid-definition and importance. Wounds-types, and management. Burns-types, severity assessment and management. Contents of an ideal first aid kit. Emergency response- CPR, and its steps. First aid in drowning and poisoning- snake bite, insect bites, and sting.

- **Basic laboratory instrumentation and techniques:** Fundamentals of Microscopy- resolution, magnification. and numerical aperture. Principles of construction, uses, advantages and disadvantages of compound microscope. Principles of centrifugation. Principles and uses of paper chromatography, Electrophoresis- principle, method and uses of agarose gel electrophoresis, Basic concepts of colorimetry.
- **Food additive and adulterants:** Food additives-definition and classification with examples. Food adulterants-definition and classification. Common adulterants in food samples-Cereals, pulses, wheat flour, besan, milk, honey, ghee, butter, coffee, turmeric powder, chilli powder, coriander powder, mustard seed/oil, and black pepper. Adulteration with rapid test by fssai. Pathophysiological effects of metanil yellow, rhodamine B, bisphenol, aluminium foil, dioxin, saccharin, monosodium glutamate, chicory, feed grade urea, malachite green and margarine.

MDC SEC Practical (2 credits; 50 Marks)

- 1) Determination of bleeding time and clotting time.
- 2) Preparation of hemin crystal.
- 3) Determination of blood group.
- 4) Assessment of BMI, ponderal index, waist-hip ratio, MUAC.
- 5) Qualitative tests for detection of common adulterants - milk (detergent, starch, water), green vegetables (malachite green), turmeric powder (metanil yellow), coffee (chicory), sugar (chalk powder).

Course outcome:

After successfully completing this course, students will be able to:

1. Explain the principles of clinical haematology, complete hemogram, blood grouping, blood transfusion, and common haematological disorders with their clinical significance.
2. Assess nutritional status using anthropometric indices and recommend appropriate dietary modifications and therapeutic diets for different age groups and common nutritional disorders.
3. Explain the principles of public hygiene, food and water safety, communicable disease prevention, waste management, and emergency first-aid procedures, including CPR.
4. Identify common food additives and adulterants, perform rapid detection tests for food adulteration, and explain their adverse effects on human health.
6. Interpret laboratory findings and anthropometric data to assess health status and correlate them with

physiological and pathological conditions.

SEMESTER-II

PAPER: MDC CC2/MN-2/MDC-Mn-2

(Chemistry of Biomolecules and Enzymes)

Total credit – 04

Total marks: 100

MDC CC2 Theory (3 Credits, 75 Marks)

- **Chemistry of Carbohydrates:** Carbohydrates-definition and classification. Monosaccharides- structure, occurrence, isomerism (stereoisomerism, optical isomerism, and epimerism) and physiological importance. Cyclic structures—pyranose and furanose. Anomerism. Mutarotation. Chemical reactions of monosaccharides (Glucose & Fructose) – reactions with concentrated mineral acids, alkali, and their biochemical importance. Disaccharides-structure, occurrence, and physiological importance of maltose, lactose and sucrose. Polysaccharides-structure, occurrence, and physiological importance of starch, glycogen, dextrin, cellulose.
- **Chemistry of Lipids:** Lipids- definition and classification. Fatty acids- classification, systematic nomenclature, and structure. Mono, di, and triglycerides. Properties of fat and fatty acids- hydrolysis, saponification, saponification number, iodine number, rancidity. Cis-trans isomerism of fatty acids. Physiological importance of phospholipids, glycolipids, sphingolipids and cholesterol. Lipoproteins-classification and functions.
- **Chemistry of Amino Acids, Peptides and Proteins:** Amino acids -classification, structure, nomenclature and optical properties. Protonic equilibrium- zwitterions, isoelectric point. Reactions with ninhydrin and formaldehyde. Peptides & proteins- structure and properties of peptide bonds. Biuret reaction. Different levels of protein structure-primary, secondary, tertiary and quaternary. Denaturation.
- **Chemistry of Purine, Pyrimidine, and Nucleic acid:** Chemistry of purine, pyrimidine -structure, nomenclature and tautomerism. Nucleosides and nucleotides—structure. Polynucleotides. DNA double helix. A-DNA, B-DNA & Z-DNA. Denaturation and annealing. RNA—Clover leaf model of tRNA.
- **Enzymes:** Enzymes classification. EC nomenclature. Concept of apoenzyme, holoenzyme, coenzyme, cofactors, and prosthetic group. Rate-limiting enzymes. Isozymes. Ribozymes and abzymes. Specificity of enzymes. Enzyme-substrate complex. Models of enzyme-substrate interactions. Concept of initial rate and maximum velocity. Michaelis-Menten equation. Michaelis constant. Significance of K_m and V_{max} . Factors influencing enzyme-catalyzed reactions. Basic concept of allosteric enzymes.

MDC CC 2 Practical (1 credit; 25 marks)

- 1) Qualitative tests for identification of physiologically important substances- Hydrochloric acid, Lactic acid, Albumin, Peptone, Gelatin, Starch, Glucose, Fructose, Lactose, Sucrose, Urea, Acetone, Glycerol, and Bile salt.
- 2) Quantitative estimation of percentage of glycine amino nitrogen (Sorensen's Formol Titration Method).
- 3) Quantitative estimation of total quantity of glycine amino nitrogen (Sorensen's Formol Titration Method).

Course outcome:

Upon successful completion of this course, students will be able to:

1. Explain the structure, classification, chemical properties, and physiological significance of carbohydrates, lipids, amino acids, proteins, nucleic acids, and enzymes.
2. Describe the structural organization, stereochemistry, reactions, and biological functions of major

biomolecules and relate their chemical properties to physiological functions.

3. Explain enzyme classification, nomenclature, catalytic mechanisms, enzyme kinetics, factors affecting enzyme activity, and the physiological significance of enzyme regulation.
4. Perform qualitative identification of physiologically important biomolecules using standard biochemical tests and accurately interpret the results.
5. Analyze biochemical laboratory observations and correlate experimental findings with the chemical and physiological properties of biomolecules.

SEMESTER-III

PAPER: MDC CC3/MN-3/MDC-Mn-3

(Digestive System, Nutrition, Dietetics and Metabolism)

Total credit – 04

Total marks: 100

MDC CC3 Theory (3 Credits, 75 Marks)

- **Digestion:** Anatomy and histology of the alimentary canal. Digestive glands and their histological structure- salivary glands, pancreas, liver, gastric and intestinal glands. Digestive juices- composition and functions of salivary, gastric, pancreatic, biliary, and intestinal secretions. Digestion and absorption of carbohydrates, proteins and lipids. Enterohepatic circulation. Deglutition and movements of the intestine. Gastric reflux and vomiting. Defecation. Gut microbiome, probiotics and prebiotics. Disorders of GI tract: Peptic ulcer, jaundice, gallstones, constipation.
- **Nutrition and Dietetics:** Food and nutrients. Concepts of macro and micronutrients. Physiological roles of Carbohydrates, proteins and lipids in nutrition. Vitamins-sources, physiological functions and deficiency symptoms of vitamin-A, D, E & K, Vitamin B complex. Minerals—Sources, physiological functions and deficiency symptoms of sodium, potassium, calcium, phosphorus, iron, iodine. RDA (As per latest ICMR guideline). Respiratory quotient, Basal Metabolic Rate-factors affecting. SDA of food.
- **Metabolism:** Carbohydrate Metabolism: pathways, energetics and metabolic significance of Glycolysis, TCA Cycle. Amphibolic roles of TCA cycle. Glycogenesis, glycogenolysis, gluconeogenesis and pentose phosphate pathways. Outline of the components of ETC. Oxidative phosphorylation. Substrate level phosphorylation. Lipid Metabolism- β -Oxidation of saturated fatty acid. Ketone body synthesis. Glucogenic and ketogenic amino acids, amino acid pool, deamination, transamination, trans -deamination. Urea cycle - metabolic pathway.

MDC CC3 Practical (1 credit, 25 marks)

- 1) Study and identification of stained sections of different parts of the digestive system: tongue, salivary gland, oesophagus, stomach, small intestine, large intestine, liver, and pancreas.
- 2) Qualitative analysis of common foodstuffs (rice, pulse, potato, milk).
- 3) Diet survey of one's own family by 24 hours recall method / weighment method.

Course outcome:

On completion of this course, students will be able to:

1. Explain the anatomy, histology, and physiological functions of the alimentary canal and associated digestive glands, and describe the mechanisms of digestion, absorption, and gastrointestinal motility with a basic idea on gut microbiome.
2. Explain the principles of human nutrition, dietary requirements, Recommended Dietary Allowances (RDA), basal metabolic rate (BMR), respiratory quotient (RQ), and the physiological significance of

macro- and micronutrients.

3. Describe the major metabolic pathways of carbohydrates, lipids, and proteins, including their regulation, energetics, and physiological importance in maintaining energy homeostasis.
4. Explain the physiological basis, clinical manifestations, and nutritional implications of common gastrointestinal disorders such as peptic ulcer, jaundice, gallstones, and constipation.
5. Demonstrate practical skills in identifying histological sections of digestive organs, performing qualitative analysis of common foodstuffs, and conducting dietary surveys using standard methods and evaluate nutritional status of a family or community.

SEMESTER-IV

PAPER: MDC CC4/MN 4/MDC-Mn-4

(Cardiovascular, Respiratory, Nerve-Muscle and Renal Physiology)

Total credit – 04

Total marks: 100

MDC CC4 Theory (3 Credits, 75 Marks)

- **Cardiovascular Physiology:** Anatomy of the heart. Properties of cardiac muscle. Stannius ligature. Origin and propagation of cardiac impulse. Cardiac cycle: Events, Heart sounds. Concept of heart rate and pulse rate. Cardiac Output-definition, measurement by application of Fick's principle and factors affecting cardiac output. Starling's law of heart. Blood pressure-definition and principle of measurement. Hypertension and hypotension. Factors affecting blood pressure. Electrocardiography- normal electrocardiogram (ECG), electrocardiographic leads. Coronary circulation-anatomy and peculiarities. Innervation of heart, baroreceptors and chemoreceptors, cardiac vasomotor centre. Cardiac reflexes - baroreceptor reflex, chemoreceptor reflex, Bainbridge reflex. Cardiovascular disorders-tachycardia, bradycardia, myocardial infarction.
- **Respiratory Physiology:** Anatomy and histology of the airways and the lungs. Mechanism of breathing- role of respiratory muscles. Alveolar surfactant. Lung volumes and capacities. Physiological dead space. Pulmonary circulation- peculiarities. Transport of gases- oxygen and carbon dioxide. Oxygen-hemoglobin dissociation curve- factors affecting. Bohr effect. Haldane effect. Regulation of respiration- neural and chemical. Hypoxia and Cyanosis, sleep apnea, asthma and COPD.
- **Nerve Physiology:** Classification, structures, and functions of neurons, neuroglia. Velocity of impulse in different types of nerve fibre. Properties of nerve fibers-excitability, conductivity, all or none law, refractory period, indefatigability, chronaxie, rheobase and utilization time. Resting membrane potential-origin. Action potential-ionic basis and propagation. Saltatory conduction. Synapse -types, structure and mechanism of transmission. EPSP, IPSP. Neurotransmitters. Neuromuscular junction-structure and transmission. EPP and MEPP. Motor unit. Degeneration and regeneration of nerve fibers. Outline of general organization and functions of Nervous system.
- **Muscle Physiology:** Structure of skeletal, cardiac, and smooth muscles. Sarcotubular system. Red and white muscle fibers, Single and multi-unit smooth muscles. Muscle groups- agonists and antagonists. Properties of skeletal muscle-all or none law, summation, beneficial effect, refractory period, tetanus, and fatigue. Excitation-contraction coupling. Mechanism of skeletal muscle contraction and relaxation, electrical, chemical, Isometric and isotonic contractions.
- **Renal Physiology:** Anatomy of the kidney. Histological structures of nephrons. JG apparatus. Peculiarities of renal circulation and autoregulation. Mechanism of formation of urine. Basic concept of Counter current multiplier and counter current exchanger systems. Non-excretory functions of the kidney. Renal

regulation of acid-base balance. Physiology of micturition. Constituents of urine- normal and abnormal with pathophysiological significance. Diabetes insipidus, Renal dialysis.

MDC CC4 Practical (1 Credit, 25 marks)

1. Measurement of arterial blood pressure by sphygmomanometer. Determination of mean pressure and pulse pressure.
2. Measurement of peak flow rate by peak flow meter.
3. Pneumographic recording of normal chest movements and effect of breath holding.
4. Identification of normal (Chloride, sulphate, phosphate, urea, creatinine) and abnormal (glucose, protein, acetone, bile salt) constituents of urine.
5. A handwritten report on field survey on any of the following (at least three physiological/ anthropometric parameters)/epidemiological studies.

Course outcome:

After successfully completing this course, students will be able to:

1. Explain the anatomy, physiology, and regulatory mechanisms of the cardiovascular system, including cardiac cycle, cardiac output, blood pressure regulation, electrocardiography, and common cardiovascular disorders.
2. Describe the structure and functions of the respiratory system, mechanisms of breathing, pulmonary gas exchange, regulation of respiration, and the physiological basis of common respiratory disorders.
3. Interpret the structure and functional properties of neurons, nerve fibres, synapses, and neuromuscular junctions, and explain the organization and functions of the nervous system.
4. Explain the structural and functional characteristics of skeletal, cardiac, and smooth muscles, including excitation-contraction coupling and the mechanisms of muscle contraction and relaxation.
5. Describe the anatomy and physiology of the kidneys, mechanisms of urine formation, renal regulation of fluid and acid-base balance, and the physiological basis of common renal disorders.
6. Develop practical skills in measuring cardiovascular and respiratory parameters, staining skeletal muscle fibres, and identifying normal and abnormal urinary constituents, while interpreting experimental observations using standard physiological techniques.

PAPER: MDC CC5

(Nervous and integumentary system, Environmental Physiology, Community & Public Health)

Total credit – 04

Total marks: 100

MDC CC5 Theory (3 Credits, 75 Marks)

- **Nervous system:** Central and peripheral nervous system. Structure and function of spinal cord. Ascending tracts- fasciculus gracilis, fasciculus cuneatus and lateral spinothalamic tract. Descending tracts- pyramidal tracts. Pain- types. Reflex action- definition, reflex arc, classification, and properties. Outline of function of brainstem. Histological structure and localisation of functions of the cerebral cortex. Different nuclei and functions of thalamus and hypothalamus. Structure and functions of cerebellum. CSF- composition, formation, circulation and functions. Organization and functions of the autonomic nervous system. Brief idea of sleep stages, speech centres in brain, learning and memory. Aphasia and Alzheimer's disease.

- **Integumentary system:** Structure and functions of skin. Cutaneous circulation-peculiarities. Sweat glands –structure and types. Sweat –composition, mechanism of formation and regulation of secretion. Sebaceous gland. Composition and function of sebum. Cerumen. Insensible perspiration. Regulation of body temperature in homeotherms - physical and physiological processes. Hyperthermia, hypothermia, and pyrexia. acne, alopecia, leukoderma and albinism.
- **Environmental Physiology:** Physiological response to high altitude- acute and chronic. Acclimatization to high altitudes. Acute mountain sickness. Effect of hyperbaric environment- Caisson's disease. Acclimatization in hot and cold environments. Heat disorders- types, symptoms and prevention. Cold related illness. Pollution-definition. Classification of pollutants. Air pollution- types, sources, and effects of pollutants on human health and preventive measures. Indoor air pollution- sources and effects. SMOG, Air quality index, Acid rain. Greenhouse effect. Water pollution- sources, impacts and preventive measures. Noise pollution- permissible ambient noise levels, impacts on human health, and control measures.
- **Community and Public Health:** Concept of Health and disease. Brief idea of community health and public health. Public health challenges in India. Communicable and non-communicable diseases with examples. Common non-communicable disease in India- etiology, and management of hypertension, diabetes mellitus, obesity, endemic goiter, nutritional anemia, rickets. Causes, symptoms, and social implications of protein calorie malnutrition. Common communicable diseases in India— etiology, and prevention of malaria, dengue, hepatitis, and AIDS. Population problem. Principles and methods of family planning. Problem of infertility and assisted reproductive technologies (ART). Principles and social importance of immunization against diseases. PM Poshan (Midday Meal Programme).

MDC CC5 Practical (1credit; 25 marks)

1. Preparation of nodes of Ranvier by silver nitrate.
2. Permanent histological slides- cerebrum, cerebellum, spinal cord, kidney, ureter, skin, lung and trachea.
3. Assessment of thermal load using WBGT index.
4. Assessment of noise at college premises by sound level meter.

Course outcome:

After completion of this course, students will be able to:

1. Explain the structural and functional organization of the central and peripheral nervous systems, including neural pathways, autonomic nervous system, reflexes, higher brain functions, and common neurological disorders.
2. Describe the anatomy and physiology of the integumentary system, mechanisms of thermoregulation, skin secretions, and the physiological basis of common skin disorders.
3. Interpret human physiological adaptations to different environmental conditions, including high altitude, hyperbaric environments, thermal stress and the effects of some pollutants on human health.
4. Explain the concepts of community and public health, communicable and non-communicable diseases, disease prevention, immunization, family planning, and public health programmes in India.
5. Develop practical skills in histological identification, preparation of nervous tissue, environmental health assessment, and field-based physiological or epidemiological surveys with appropriate interpretation of findings.

SEMESTER-V**PAPER: MDC CC6/MDC-Mn-5**

(Special Senses, Endocrine and Reproductive Physiology)

Total credit – 04

Total marks: 100

MDC CC6 Theory (3 Credits, 75 Marks)

- **Special Sense:** Characteristics of special senses. Weber-Fechner law, Steven's power law. Olfaction and gustation -receptor organs, neural pathways and centers. Signal transduction of olfactory and gustatory stimuli. After taste. Structure and functions of auditory apparatus. Organ of Corti -Structure and its role in hearing. Auditory pathway. Signal transduction of auditory stimuli. Hearing loss. Outline structure of eyeball. Crystalline Lens. Histology of Retina. Visual pathway- receptors, course, termination and centers. Mechanism of accommodation. Light reflex. Aqueous humor- functions. Basic concepts of photopic and scotopic vision. visual acuity, and colour vision. Light and dark adaptation. Positive and negative after images. Myopia and hypermetropia.
- **Cell signalling:** Cell surface receptor proteins – ion channel coupled, G-protein coupled and enzyme-coupled. Intracellular messengers – cAMP, cGMP, IP3, DAG, Ca²⁺, Protein kinases.
- **Endocrinology:** Hormones-classification. Elementary idea of mechanism of hormone action. Hypothalamus as a neuroendocrine organ. Hypothalamic-hypophyseal tract and portal system. Hypothalamic releasing and inhibitory hormones. Feedback regulation- basic concept. Pituitary gland- histology, chemical nature, and functions of hormones. Dwarfism and acromegaly. Thyroid and Parathyroid Glands- histological structures, chemical nature, and functions of hormones. Myxoedema, cretinism and goitre. cortex and medulla- histology, chemical nature, and functions of adrenal hormones. Cushing's syndrome. Pancreas- Histological structure of pancreatic islets, chemical nature, and functions of the hormones. Diabetes mellitus. Pineal gland and melatonin. Brief idea of gastrointestinal hormones- gastrin, secretin, CCK-PZ.
- **Reproductive Physiology:** Basic anatomy of male and female reproductive systems. Primary and accessory sex organs and secondary sex characters. Male reproductive system- histology of testis, spermatogenesis, testicular hormones and their functions. Female reproductive system- histology of ovary. Oogenesis. Ovarian hormones and their functions. Menstrual cycle and its hormonal control, Menarche, and menopause. Fertilization, early embryogenesis and implantation. Structure and functions of placenta, Maintenance of pregnancy- role of hormones. Parturition. Lactation- basic idea.

MDC CC6 Practical (1 credit, 25 marks)

1. Determination of Visual acuity by Snellen's chart.
2. Deafness test using Tuning fork.
3. Assessment of colour blindness by Ishihara chart.
4. Permanent slides- thyroid gland, adrenal gland, testis, ovary, uterus, spleen, artery, vein.

Course outcome:

After completion of this course, students will be able to:

1. Explain the structure and functions of the special sense organs and describe the physiological mechanisms of vision, hearing, taste, and smell, including sensory transduction and neural pathways.
2. Describe the principles of cell signalling, classify cell surface receptors, and explain the roles of intracellular second messengers in cellular communication.
3. Explain the organization and functions of the endocrine system, mechanisms of hormone action, feedback regulation, and the physiological basis of common endocrine disorders.

4. Describe the anatomy, histology, and physiology of the male and female reproductive systems, including gametogenesis, hormonal regulation, fertilization, pregnancy, parturition, and lactation.
5. Perform basic physiological and histological laboratory techniques related to sensory physiology and endocrine/reproductive histology, and interpret normal findings.

PAPER: MDC CC7

(Histology, Clinical Biochemistry, Molecular Biology, Evolution and Biostatistics)

Total credit – 04

Total marks: 100

MDC CC7 Theory (3 Credits, 75 Marks)

- **Histological techniques:** Tissue fixation: objectives, classification and examples of fixatives Choice of fixatives. Dehydration-steps and significance, Clearing-agents and significance. Embedding- paraffin wax, Microtomy-working principle and uses of rotary microtome. Dyes and stains in histology-types and examples. Staining methods: Methylene Blue, Silver nitrate and Haematoxylin-eosin.
- **Clinical Biochemistry:** Carbohydrates: fasting, postprandial, and random blood glucose, HbA1C, hyper & hypoglycemia. Lipids-lipid profile and atherosclerosis. Proteins: total protein, serum albumin, albumin: globulin ratio. Pathophysiological significance of urea, creatinine, uric acid, bilirubin, sodium, potassium. Pathophysiological significance of lactate dehydrogenases, pancreatic amylase, alkaline phosphatase, SGOT, SGPT, Cardiac troponins. Thyroid profile (T3, T4, TSH).
- **Molecular Biology:** Basic concepts of Central Dogma of Molecular Biology. DNA replication, transcription and translation in prokaryotes. Regulation of Gene Expression in prokaryotes- lac operon. Application of recombinant DNA technology in human health- recombinant insulin. Gene therapy-basic concept.
- **Human evolution:** Definition and significance of evolution. Convergent and divergent evolution. Evidence in evolution-morphological, embryological, and paleontological. Geological time scale, Brief Overview of evolutionary theories: Lamarckism, Darwinism, and Modern Synthesis. Origin of Homo sapiens and comparison with earlier species–Australopithecus, Homo habilis, Homo erectus and Neanderthals. Major transitions in hominin Evolution- Bipedalism, evolution of brain size and intelligence. Population genetics: Hardy Weinberg Equilibrium.
- **Biostatistics:** Concept of Variables, Population & sample. Parameters and statistics. Presentation of data- Frequency distribution, Pie diagram, Bar diagram, Frequency polygon, Histogram. Central tendencies- mean, median and mode. Standard deviation and standard error.

MDC CC 7 Practical (1 credit. 25 marks)

1. Calculation of Mean, median, mode.
2. Pie diagram, bar diagram using physiological data.
3. Random blood glucose estimation using glucometer.
4. Identification of hominins from photographs- Australopithecus, Homo habilis, Homo erectus and Neanderthals.

Course outcome:

On successful completion of this course, students will be able to:

1. Describe the principles and applications of histological techniques, including tissue processing, microtomy, and staining methods.
2. Interpret basic clinical biochemical parameters and correlate them with normal physiology and common

disease conditions.

3. Describe the fundamental concepts of molecular biology, gene expression, recombinant DNA technology, and gene therapy.
4. Explain the principles of human evolution, population genetics, and basic biostatistics for analysis and interpretation of biological data.
5. Perform basic laboratory techniques in biochemistry and biostatistics, prepare graphical presentations of data, and identify major hominin species.

SEMESTER-VI

PAPER: MDC CC8/MDC-Mn-6

(Microbiology, Immunology, Work and Sports Physiology, Ergonomics and Occupational Health)

Total credit – 04

Total marks: 100

MDC CC8 Theory (3 Credits, 75 Marks)

- **Microbiology:** Bacterial structure, Bacterial classification based on staining techniques (Gram stain & acid-fast stain) and morphological aspects. Culture of bacteria- nutritional requirements, complex and synthetic media, Physical factors required for growth. Bacterial growth curve. Microbial growth in response to environment -temperature, pH, solute and water activity, and oxygen. Pathogenic and non-pathogenic bacteria with examples. Control of microbial growth- physical and chemical methods used in sterilization, disinfection, and pasteurization. Elementary idea of antibiotics- bactericidal and bacteriostatic actions. Structure of virus -virion, prion and bacteriophages, Classification of viruses based on nucleic acid composition and host system, Interferons.
- **Immunology:** Overview of active and passive immunity. Innate and acquired/ adaptive immunity. Barriers of innate immunity. Immunogens, and antigens-requirements of immunogenicity, haptens; epitopes. Adjuvants. Antibody- structure, types, functions, and properties. Antigen-Antibody interactions- neutralization, precipitation, opsonization and agglutination. Primary and secondary immune response. Generation of Humoral Immune and Cell Mediated Immune Response. Hypersensitivity- types with examples. Inflammation. Autoimmunity. Vaccination-Types of vaccines. Toxins and toxoids.
- **Sports Physiology:** Concept of endurance, strength, and speed in sports activities. Muscle fibre-types and performance. Sources of energy. Concept of maximum physical work capacity-factors affecting, and measurement by bicycle ergometer. Significance of maximal oxygen consumption (VO_2 max) and excess post-exercise oxygen consumption (EPOC). Aerobic and anaerobic capacity. Lactate threshold, Training principles for different sports activities. Physical fitness and its assessment by modified Harvard Step Tests, Ergogenic Aids. Doping- dope substances and drug abuse in sports.
- **Work and Exercise Physiology:** Fundamental concepts of work- different categories of work. Physical work, its definition, and nature—isotonic, isometric, isokinetic, positive, and negative work. Concept of physiological work. Workload – light, moderate (submaximal) and heavy (maximal) depending on intensity and duration of work. Physiological responses to work –cardiovascular, respiratory, metabolic, and muscular – short-term and long-term. Work-rest cycle and importance of rest pause. Muscular fatigue- central and peripheral fatigue in physical work.
- **Ergonomics and Occupational Health:** Introduction to Ergonomics -definition, and classification. Concept of man-machine-environment interaction. Role of ergonomics in the improvement of

productivity and ensuring industrial safety. Ergonomic assessment of workplace: Illumination, temperature and noise. Introduction to Occupational Health- definition and importance. Occupational Hazards –types Causative factors, physiological effects, and preventive measures of common occupational diseases- - asbestosis, silicosis, byssinosis, pneumoconiosis, and noise-induced hearing loss. Definition of personal protective device (PPD) and efficacy of using personal protective device in different work related hazardous sectors.

MDC CC8 PRACTICAL (1 credit, 25 marks)

- 1) Assessment of PFI by modified Harvard step test.
- 2) Assessment of $\dot{V}O_2$ max by Queens college test.
- 3) Measurement of Handgrip strength by handgrip dynamometer.
- 4) Lactophenol Cotton Blue staining of dietary yeast.

Course outcome:

After successful completion of this course, students will be able to:

1. Describe fundamental concepts of microbiology, including bacterial structure, classification, growth, culture techniques, microbial control methods, antibiotics, and viruses.
2. Explain the basic principles of immunology, including innate and adaptive immunity, antigen-antibody interactions, immune responses, hypersensitivity, autoimmunity, inflammation, and vaccination.
3. Apply knowledge of sports and exercise physiology to evaluate physical fitness, energy metabolism, aerobic and anaerobic capacity, muscular performance, and physiological responses to exercise.
4. Understand ergonomic principles and their role in improving workplace efficiency, safety, and the interaction between humans, machines, and the environment.
5. Identify occupational hazards and diseases and recommend preventive strategies, including the appropriate use of personal protective devices (PPDs).
6. Develop practical laboratory skills in microbiological staining techniques, physiological assessment methods, data collection, and interpretation.

Suggested Readings for Major Courses

General Physiology

1. Ganong's Review of Medical Physiology, Kim E. Barrett et al., McGraw-Hill Education
2. Guyton and Hall's Textbook of Medical Physiology, John E. Hall, Elsevier
3. The Living Body: A Text in Human Physiology (Best and Taylor's Physiological Basis of Medical Practice), John B. West, Taylor and Francis
4. Physiology, R. M. Berne, M. N. Levy, Elsevier Mosby
5. Lippincott Illustrated Reviews: Physiology, R. R. Preston, T. E. Wilson, Wolters Kluwer
6. Human Physiology: The Mechanisms of Body Function, A. J. Vander, J. H. Sherman, D. S. Luciano, McGraw-Hill
7. Boron & Boulpaep Concise Medical Physiology, By Walter F. Boron, Emile L. Boulpaep
8. Medical Physiology for Undergraduate Students, I Khurana & A Khurana, Elsevier India
9. Textbook of Medical Physiology, Indu Khurana, Arushi Khurana & N G Kowlgi, Elsevier India
10. Essentials of Medical Physiology, K. Sembulingam, Perumal Sembulingam, Jaypee Brothers Medical Publishers
11. Human Physiology, Volume 1 & 2, C. C. Chatterjee, CBS Publishers & Distributors
12. Principles of Physiology, Debasis Pramanik, Jaypee Brothers Medical Publishers
13. Human Physiology: An Integrated Approach, D. U. Silverthorn, Pearson Education

14. Human Physiology: From Cells to Systems, L. Sherwood, Cengage Learning
15. Fundamentals of Human Physiology, L. Sherwood, Cengage Learning
16. Human Physiology, S. I. Fox, McGraw-Hill Education
17. Principles of Anatomy and Physiology, G. J. Tortora, Bryan H. Derrickson, Wiley
18. Seeley's Anatomy & Physiology. A. Russo, C. Van Putte, J. Regan, McGraw-Hill
19. Text Book of Physiology. Vols. I & II by H.D. Patton. A.F. Ruchs. B. Hille. W.B. Saunders of Co.
20. Samson Wright's Applied Physiology, C.A. Keele. E Neil & N. Toels. Oxford University Press.

General Biochemistry

1. Leininger's Principles of Biochemistry. By D.L. Nelson and M. M. Cox, Worth Publishers Inc.
2. Harper's Illustrated Biochemistry, V.W. Rodwell and others, Lange
3. Biochemistry, D. Das, Academic Publishers.
4. Lippincott Illustrated reviews Biochemistry, D. R. Ferrier, Wolter Kluwer.
5. Text Book of Biochemistry with Clinical Correlations, T.M. Devlin John Wiley and Sons.
6. Text Book of Biochemistry, by E.S. West. W.R. Todd. H.S. Mason. J.T. Van Bruggen. The Macmillan Company.
7. Textbook of Medical Biochemistry, R. Chawla et.al, Wolters-Kluwer
8. Biochemistry, J.M. Berg, J.L. Tymoczko & L. Stryer, W.H. Freeman Williams
9. Biochemistry. Satyanarayana Chakrapani. Elsevier Pub.

Anatomy

1. Handbook Of General Anatomy. B. D. Chaurasia. CBS Publishers.
2. Principles of General Anatomy. A. K. Dutta. Current Books International.
3. Anatomy Physiology, K.S. Saladin, McGraw-Hill.
4. Human Anatomy & Physiology. E.N. Marieb and K. Hoehn. Pearson.

Biophysics & Biophysical principles

1. Biophysics and Biophysical Chemistry, D. Das. Academic Publishers.
2. Introduction to Biophysics. Pranav Kumar. S Chand.
3. Biophysical Chemistry, Principles and Techniques. Upadhyay, Upadhyay, Nath. Himalayan Publishing House
4. Biophysics, An Introduction, R. Cotterill. Wiley
5. A Textbook of Biophysics. R.N. Roy, New Central Book Agency (P) Limited

Biostatistics

1. Statistics in Biology and Psychology by D. Das and A. Das. Academic Publishers.
2. Medical Statistics by B.K. Mahajan. Jaypee Brothers, Medical Publishers Pvt. Ltd.
3. An Introduction to Biostatistics, N. Gurumani, M.J.P. Publishers, Chennai.
4. Biostatistical Analysis by J.H Zar, Pearson.
5. Statistical Methods in Biology, Norman T.J. Bailey, Cambridge University Press.
6. Essentials of Biostatistics & Research Methodology. I. Saha and B. Paul. Academic Publishers
7. Biostatistics, Computer applications and Bioinformatics. Er. A. Gopi et al. Saras Publication

Cancer Biology

1. Textbook of Cancer Biology. Dr. Pradeep Kumar. Prachi Digital Publication.
2. Molecular and Cell Biology of Cancer. Rita Fior and Rita Zilhao (eds). Springer

Cell & Molecular biology

1. The Cell – A Molecular Approach, G.M. Cooper & R.E. Hausman, ASM Press SINAUER.
2. Cell Biology, G. Karp, John Wiley & Sons, Inc. Core
3. Cell & Molecular Biology, EDP De Robertis & EMF De Robertis; Lea & Febiger

4. Molecular Biology of the Gene, by J.D. Watson, H.H. Nancy & others; Benjamin Cummings.
5. Molecular Biology of the Cell, B. Alberts and others, Garland.
6. Molecular Cell Biology, Berk, Kaiser, Lodish et.al, WH Freeman.
7. Cell Biology, Genetics and Molecular Biology. Halder, Kar. NCBA.

Chronobiology

1. Chronobiology – The Biological Timekeeping, J.C. Dunlap, Sinauer Associates
2. The Rhythm of Life, M. Kelly, The New York Times Bestseller
3. Biological Rhythms, Vinod Kumar, Narosa Publishers

Clinical Biochemistry

1. Practical Clinical Biochemistry. Methods & interpretation. Ranjana Chawla. Jaypee Brothers Medical.
2. Practical Clinical Biochemistry. H Varley. CBS Pub.

Community Health & Epidemiology

1. Park's Textbook of Preventive and Social Medicine, K. Park, M/s. Banarasidas Bhanot.
2. Communicable Disease Control Handbook, Jeremy Hawker et.al, Blackwell Publishing
3. Mahajan BK, Roy RN, Saha I, Gupta, MC. Textbook of Preventive and Social Medicine, Jaypee Brothers Medical Publishers.
4. Essential of Community Medicine. Aviraj K S. White Falcon Publishing.
5. Manual of First aid. LC Gupta. Jaypee Brothers Medical.
6. First Aid Manual. Sanju Sira. CBS Publishers.

Embryology

1. Langman's Medical Embryology by J.W. Sadler, Lippincott Williams and Wilkins.
2. Essentials of Human Embryology by A.K. Datta. Current Books International.
3. Human Embryology. I. Singh & G.P. Pal. McMillan.
4. Carlson BM. 2014. Human Embryology and Developmental Biology. 5th Edn. Elsevier.

Endocrinology:

1. William's TextBook of Endocrinology, S. Melmed, K. S. Polonsky, P.R. Larsen, H. M. Kronenberg, Elsevier.
2. Endocrinology, M. E. Hadley, Pearson Education
3. Behavioural Endocrinology, R.J. Nelson, Sinauer Associates
4. Endocrinology. Vol. I, II and III, L.O. DeGroot. W.B. Saunders Co. Langman's
5. Endocrine Physiology, P. E. Molina, McGraw Hill Lange.
6. Introduction to Endocrinology by Chandra S. Negi, PHI Learning Pvt. Ltd.

Environmental Physiology/Pollution

1. Pesticides by P.K. Gupta, Interprint. 4
2. Environmental Chemistry by P.K De. Wiley Eastern Ltd.
3. Water Pollution. Causes effects and Control. P K Goel. New Age Internationals.
4. Textbook of Air Pollution and its Control. S C Bhatia. Atlantic Publication.

Ergonomics

1. Fitting the task to the man: A textbook of Occupational Ergonomics. KHE Kroemer and E Grandjean. Taylor and Francis.
2. Engineering Physiology: Bases of Human factors / Ergonomics, KHE Kroemer and HB Kroemer. Van Reinhold.
3. Body space: Anthropometry, Ergonomics and Design. S. Pheasant, Taylor and Francis
4. Human Factors in Engineering. EJ McCormick and H Saunders. 5th Edition. McGraw-Hill.
5. Ergonomics Man in His Working Environment. Murrell K. 3rd Ed. Springer.
6. Introduction to Human Factors and Ergonomics, R.S. Bridger, Routledge: Taylor & Francis group.

7. Occupational health, industrial safety. and Ergonomics for beginners. Dr. Subhashis Sahu. Spellbound.

Genetics

1. Genetics: Analysis of Genes and Genomes, D. L. Hartl, E. W. Jones, Jones & Bartlett Publishers
2. Genetics, G. Strickberger, Pearson Education
3. Genetics, P. J. Russell, Pearson Education
4. Genetics: A Conceptual Approach, B. A. Pierce, W. H. Freeman and Company
5. An Introduction to Genetic Analysis, A. J. F. Griffiths, J. H. Miller, D. T. Suzuki, R. C. Lewontin, W. M. Gelbart, Macmillan Learning
6. Problems on Genetics, Molecular Genetics and Evolutionary Genetics, P. K. Banerjee, Books and Allied (P) Ltd.
7. Fundamentals of Genetics, B. D. Singh, Medtech Science Press.
8. Essentials of Medical Genetics. Dr Asim Kumar Dutta. A.R.K. Publications.
9. Cell biology, Genetics, Evolution & Ecology. P S Verma. S Chand.
10. Genetics. Veer Bala Rastogi. Medtech.

Haematology

1. Practical Haematology. Dacie and Lewis, Churchill Livingstone, 10th edition.
2. Essential Haematology. A.V. Hoffbrand, J. E. Pettit, P. H. A. Moss and Hoffbrand V. Blackwell Scientific Publications
3. Haematology: Basic Principles and Practice, Ronald Hoffman, Edward J. Benz Jr., Leslie E. Silberstein, Helen Heslop, Jeffrey Weitz, John Anastasi, Elsevier
4. Wintrobe's- Clinical Haematology, J. P. Greer et.al., Wolters Kluwers
5. William's Haematology, E. Beutler et. Al., Mc Grawhil.
6. Essentials in Haematology and Clinical Pathology. R Nayak, S Rai. Jaypee Brothers Medical Publishers.

Histology

1. DiFiore's Atlas of Histology, V.P. Eroschenko, Wolters-Kluwer
2. Basic Histology, L.C. Junqueira & J Carneiro, McGraw- Hill.
3. Bailey's Text Book of Histology, revised by W.M. Copenhaver; The Williams and Wilkins Company.
4. Carleton's Histological Techniques, by R.A.B. Drury & E.A. Wellington, Oxford University Press.

Human Evolution

1. The Study of Science: Human Evolution. Rusty Huddle (ed). Britanica.
2. Human Evolution. Bernard Campbell. Taylor and Francis Inc.

Immunology

1. Kuby Immunology, T. J. Kindt, R. A. Goldsby, B. A. Osborne, W. H. Freeman
2. Essential Immunology, I. M. Roitt, Blackwell Scientific Publications
3. Cellular and Molecular Immunology, A. K. Abbas, A. H. Lichtman, S. Pillai, Elsevier
4. Janeway's Immunobiology, K. Murphy, P. Travers, M. Walport, Garland Science
5. Fundamental Immunology, W. E. Paul, Lippincott Williams & Wilkins

Instrumentation & Methodology

1. Biomedical Instrumentation & Measurements, L. Cromwell, F. J. Weibel, E. A. Pfeiffer, Prentice-Hall
2. Handbook of Biomedical Instrumentation, R. S. Khandpur, Tata McGraw-Hill
3. Biophysics and Molecular Biology: Tools & Techniques, Pranav Kumar, Pearson
4. Introduction to Biomedical Instrumentation, D. J. Walker, Palgrave Macmillan
5. Physical Biochemistry: Principles and Applications, D. Sheehan, Wiley-Blackwell

Microbiology

1. Microbiology, Pelczar Tata McGraw-Hill.
2. General Microbiology. Stanier et.al, Prentice Hall.
3. Microbiology An Introduction, G.J Tortora, Pearson.
4. Prescott's Microbiology, J. Willey et.al., McGraw-Hill
5. Essentials of Medical Microbiology. Apurba S Sastry. Jaypee Brothers Medical.
6. Textbook of Microbiology. R Ananth Narayan and Paniker. Universities Press (India) Pvt. Ltd.

Neurophysiology

1. Neurobiology, G.M. Shepherd, Oxford University Press
2. Text Book of Neuro-Anatomy, M.B. Carpenter; the Williams and Wilkins Company.
3. The Human Nervous System, C. Nobach, McGraw Hill Book Co.
4. The Human Nervous System, M.L. Barr & J.A. Kierman, Harper & Row. Essential
5. Neuroscience-by Dale Purves, George J Augustine, David Fitzpatrick, Lawrence C Katz, Anthony-Samuel LaMantia, James O McNamara, and S Mark Williams.
6. Principles of Neural Science, Eric R. Kandel, James Harris Schwartz, Thomas Jessell. McGraw-Hill Companies.
7. Lippincott illustrated Reviews: Neuroscience. South Asian edition, Wolters Kluwer India.
8. Essentials of Neuroanatomy. A K Dutta. Current Books International.

Nutrition & Dietetics

1. Food and Nutrition. M. Swaminathan. The Bangalore Printing & Publishing Co.
2. Nutritive Value of Indian Foods. C. Gopalan and others. NIN, Hyderabad.
3. Nutrition Science. B. Srilakshmi. New Age International (P) Ltd.
4. Davidson and Passmore's Human Nutrition & Dietetics. R. Passmore and M.A. Eastwood. Churchill Livingstone.
5. Clinical Dietetics and Nutrition. F. P. Anita and P. Abraham. Oxford University Press, Delhi.
6. Fundamentals of Foods and Nutrition. S.R. Mudambi and M.V. Rajgopal. Wiley Eastern Ltd, 1990.
7. Nutrient Requirements and Recommended Dietary Allowance for Indians, Indian Council of Medical Research: New Delhi.
8. Rapid Detection of Food Adulterants and Contaminants: Theory and Practice Shyam Narayan Jha. Academic Press.

Parasitology

1. Biology of Disease. N. Ahmed, M. Dawson, C. Smith, E.D. Wood. Taylor and Francis Group.
2. Medical Parasitology. D.R. Arora and B. Arora. CBS Publications and Distributors
3. Textbook of Medical parasitology. P. Chakraborty. New Central Book Agency.
4. Essentials of Medical Parasitology. Apurva S Sastry. Jaypee Brothers Medical.

Pharmacology

1. Goodman and Gilman's The Pharmacological basis of Therapeutics, McGraw-Hill.
2. Basic and Clinical Pharmacology by E. G Katzung. Appletons and Lange.
3. Textbook of Pharmacology by Seth and Seth Elsevier.
4. Essentials of Medical Pharmacology. K D Tripathy. Jaypee Brothers Medical Publishers.

Space Biology & Aviation

1. Astrobiology and space medicine. Amartya Nandi and Bhaskar R. Puri. Notion Press.
2. Fundamentals of Space Biology. Makoto Asashima and George M Malacinski. Japan Scientific Societies Press. Springer Verlag.

Stem cell biology

1. Essentials of Stem Cell Biology. Robert Lanza and Anthony Atala (eds). Elsevier.
2. Concepts and Applications of Stem Cell Biology. Gabriela Rodrigues and Bernard Roelen. Springer.

Stress physiology

1. Physiology of Stress, Hans Selye, Jones, and Bartlett Publishers
2. Free Radicals in Biology and Medicine by Barry Halliwell, John M. C. Gutteridge, Oxford University Press

Work, Exercise, Sports Physiology

1. Exercise Physiology: Theory and Application to Fitness and Performance. S.K. Powers and E.T. Howley. 10th edition. McGraw Hill publishers.
2. Exercise Physiology: Nutrition, Energy, and Human Performance. W.D. McArdle, F.I. Katch and V.L. Katch. 7th edition. Lippincott, Williams & Wilkins publishers.
3. Physiology of Sport and Exercise. J. H. Wilmore, D. L. Costill, W. Larry Kenney. Human Kinetics
4. Textbook of Work Physiology: Physiological Bases of Exercise. Per- Olof Åstrand, Kaare Rodahl, Hans A. Dahl, Sigmund B. Strømme. Human Kinetics
5. Fox's Physiological Basis for Exercise and Sport by M. L. Foss. S. J. Keteyian, E. L. Fox , William C Brown Pub
6. The Physiology of Work, K. Rodahl, Taylor & Francis,
7. Essentials of Exercise Physiology, V.L. Katch, W.D. McArdle, F.I. Katch, Wolters Kluwer

Practical Physiology

1. Ghai's Textbook of Practical Physiology. V.P. Varshnay and Monal Bedi. Jaypee Brothers Medical Publishers.
2. Practical Physiology Book. M. Chandrasekar and Nitesh Mishra. Jaypee Brothers Medical Publishers.
3. Textbook of Practical Physiology. G. K. Pal and Pravati Pal. Universities Press.
4. Practical Physiology. Prasunpriya Nayak. Taurean Publications.
5. Practical Biochemistry. Nita Sahi. Jaypee Brothers.
6. Practical Biochemistry. Ranjana Chawla. Jaypee Brothers.

PSI Lab Notebooks:

1. *Note Book on Practical Biochemistry (Published by the Physiological Society of India, Kolkata.)*
2. *Note Book on Experimental Physiology (Published by the Physiological Society of India, Kolkata.) and*
3. *Notebooks on Histology (Published by the Physiological Society of India, Kolkata.)*

Note: In order to maintain the uniformity of practical knowledge among the students of different Colleges, The Physiological Society of India has published Practical Note Books on Physiology comprising syllabi of different Universities, including Calcutta University with the help of experienced teachers of both Honours and General teaching degree colleges. Hence, members of the Undergraduate Board of Studies in Physiology recommend the aforesaid Note Books for use by the students in undergraduate 4 yr Hons, and 3 yr. MDC. course in Physiology.

Suggested Readings for Minor & MDC Courses:

1. CC Chatterjee's Human Physiology. Volumes I and II. CBS Publishers and Distributors Pvt Ltd.
2. Concise Medical Physiology. Sujit K. Chaudhuri. New Central Book Agency.
3. Essentials of Medical Physiology. K.Sembulingam and P. Sembulingam. Jaypee Brothers Medical Publishers (P) Ltd.
4. Essentials of Medical Physiology. A.B.S. Mahapatra and G.S. Mahapatra. Current Books International.
5. Principles of Physiology, D.Pramanik, Academic Publishers, Kolkata.
6. Joshi's Physiology: Prep Manual for Undergraduates, Sadhana Joshi-Mendhurwar. Elsevier
7. Parks Text Book of Preventive and Social Medicine. K.Park. Banarasidas Bhanot Publishers
8. Biochemistry. D.Das. Academic Publishers.

9. Biochemistry. U.Satyanarayana and U. Chakrapani. Elsevier.
10. Biophysics. R. N. Roy. New Central Book Agency
11. A Text Book of Microbiology. P.Chakraborty.New Central Book Agency.
12. Immunology: Introductory Text Book. Nandini Shetty. New Age International Publishers.
13. Exercise Physiology and Ergonomics. Asis Goswami. Academic Publishers.
14. Physiological basis of Sports and Exercise Sciences.Dr. Anupam Bandyopadhyay. Notion Press.
15. *Sharirbigyan* (Bengali) Vol. I & 2, J. Debnath, Sridhar Prakashani.
16. *Byaboharik Sharirbigyan*. (Bengali). J Debnath. Sridhar Prakashani
17. *Paripak, Bipak O Pusti*,(Bengali) D. Das, Paschim Banga Rajya Pustak Parshad.
18. *Snatak Sharirbidya*, (Bengali). A. Bandopadhyay, Calcutta Book House.
19. *Snatak Sharirbidya*. (Bengali). Masanta Das, Santra Publication.
20. Practical Physiology (Bengali), by M.K. Manna, Sritara Prakashani, Kolkata
21. Nutritive Value of Indian Foods by C. Gopalan and other, NIN, Hyderabad. 20.

Modalities of Internship in Physiology

- 1) **Duration of Internship:** 15days (60 working hours) From 16th May to 30th May each Year
- 2) **Full marks:** 75 (3 credits)
- 3) **Guideline for Evaluation:**
 - a) Submission of Internship report and completion certificate - 20
 - b) Assessment of work done during internship - 20
 - c) Attendance: 10
 - d) Viva- Voce- 25

Physiology

Summer Internship Programmes

- a) Internship on Data processing and Statistical analysis programmes—Students can learn data analysis and how to draw conclusion from acquired data of different kinds of projects
- b) Internship on Ergonomic Engineering—In a limited time frame they can have hands-on training ,maybe of only one furniture/instrument's ergonomic designing and implementation and can pursue it in future.
- c) Internship on Biotechnological laboratory processing—To offer students exposure to the designing, development, and testing of physiological monitoring devices and instrumentation. This internship can include opportunities for students to get exposed to the importance of modern techniques and methodologies and quality assurance protocols relevant to the modern research area.
- d) Internship on Special Nutritional requirements of different sports sectors—Students interested in sports Physiology can work on different sports performers to get an exposure on how sports persons groom and maintain themselves.
- e) Internship on Scientific Anti depression Counseling and dance/other therapy--will expose students to do community services.
- f) Internship on Epidemiological Studies on different area based tropical diseases—Students will have an idea of how the community of the area suffers and what can be the remedy for that .
- g) Internship on Occupational Safety programmes—Internship will expose students towards the importance of safety measures in different types of professions
- h) Internship on Clinical Physiology Internship: Partner with hospitals or medical centers to offer students the opportunity to observe and assist in clinical settings. Students can shadow healthcare professionals such as physiologists, nurses, and physicians, gaining firsthand experience in assessing patient vital signs, interpreting diagnostic tests, and understanding the physiological basis of various medical conditions.
- i) Internship on Environmental Physiology Research: Partner with environmental research Institutes or conservation organizations to offer students the opportunity to study the physiological adaptations of organisms to different environmental conditions. This internship can involve fieldwork activities such as data collection, sample analysis, and ecological monitoring to understand how physiological processes are influenced by environmental Factors.
- j) Internship on Bioinformatics and Computational Physiology: Collaborate with bioinformatics labs or computational biology research groups to create an internship program focused on analyzing physiological data using computational methods. Students can learn about bioinformatics tools, statistical analysis techniques, and modeling approaches to study complex physiological systems and biological processes.

Advisors and Contributors

1. Prof. Sanjit Dey. Chairman, UGBOS in Physiology, University of Calcutta.
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12. Dr. Arnab Chaudhuri. Associate Professor in Physiology, City College.
13. Dr. Barnali Ray Basu. Associate Professor in Physiology, Surendranath College.
14. Dr. Labonya Mandal. Assistant Professor in Physiology, Raja Peary Mohan College.
15. Dr. Raghawendra Misra. Assistant Professor in Physiology, Ananda Mohan College.
16. Dr. Tamal Das. Assistant Professor in Physiology, Vidyasagar Metropolitan College.

Annexure I

Course Structure- 4 yr Honours and Honours with Research (NEP 2020)

PHYSIOLOGY

UNIVERSITY OF CALCUTTA

Third Year

Sem		DSCC/Core/ RM (Major)	Minor	IDC	AEC	CVAC	SEC	Summer Internship	Research Internship	Dissertation Project	Total Credits
V	Course	PHYM DSCC9 (3TH +1P) Nervous System	MPHY-MN 3 (3TH +1P) Digestive System, Nutrition, Diet .and Metabolism								20
		PHYM DSCC10 (3TH +1P) Endocrinology	MPHY-MN 4 (3TH +1P) Cardiovascular, Respiratory, Nerve Muscle & Renal Physiol								
		PHYM DSCC11 (3TH +1P) Reproductive & Developmental Biology									
		PHYM DSCC12 (3TH +1P) Community, Public, Occupational health & Ergonomics									
	Credit	4 x 4= 16 Credit	4 x2= 8 Credit			-		-	-	-	
VI	Course	PHYM DSCC 13 (3TH +1P) Special Senses & Chronobiology	MPHY-MN 3 (3TH +1P) Digestive System, Nutrition, Diet .and Metabolism					Summer Internship			20
		PHYM DSCC 14 (3TH +1P) Excretory Physiology and Work & Sports Physiology	MPHY-MN 4 (3TH +1P) Cardiovascular, Respiratory, Nerve Muscle & Renal Physiol								
		PHYM DSCC 15 (3TH +1P) Microbiology and Immunology									
	Credit	4 X 3=12 Credit	4x 2 = 8 Credit					3 Credit **	-	-	
Students on exit shall be awarded B.Sc. with Single Major in Physiology after securing the requisite 132 credits at the end of Semester VI											40

Fourth Year

Sem		DSCC/Core (Major)	Minor	IDC	AEC	CVAC	SEC	Summer Internship	Research Internship	Dissertation Project	Total Credits
VII	Course	PHYM DSCC 16 (4TH) Biotechnology, Bioinformatics and Cancer Biology									20
		PHYM DSCC 17 (4TH) Pharmacology, Toxicology & Stress Physiology									
		PHYM DSCC 18 (4TH) Advanced Sports, Ergonomics and Physiology in Space.									

		PHYM DSCC19 (4P) Practical									
		PHYM DSCC 20 (4P) Practical									
	Credit	4 x 5 = 20 Credit				-		-	-	-	
Honours. with Research											
VIII	Course	PHYM RM-1 (3TH+1V) Research Methodology-I							Research Internship (3TH +1V)	Dissertation (6TH +2V)	20
		PHYM RM-2 (3TH +1V) Research Methodology II									
	Credit	4 x2 = 8 Credit							4 Credit	8 Credit	
Honours. without Research											
VIII	Course	PHYM RM-1 (3TH+1Viva) Research Methodology I									20
		PHYM RM-2 (3TH +1Viv) Research Methodology II									
		PHYM DSCC 21 (4TH) Evolution and Comparative Physiology									
		PHYM DSCC 22 (4TH) Ecology and Population Biology									
		PHYM - Review- (3TH +1V) Review work									
	Credit	4 X 5=20 Credit							-	-	
Students on exit shall be awarded B.Sc. with Honours/ Honours with research in Physiology after securing the requisite 172 Credits at the end of Semester VIII											40

Total credits & Marks (semester-1 to 8) for 4-Yr. B.Sc. Honours With Research Courses of Studies

	DSCC/RM	Minor (2)	IDC	AEC	CVAC	SEC	Summer Internship	Research Internship	Dissertation	Total
Credit	22X4=88	8X4=32	3X3=9	4x2=8	4x2=8	4X3=12	1X3=3	1X4=4	1X8=8	172
Marks	22X 100= 2200	8X100=800	3X75=225	4c 50=200	4c 50=200	3X100=300	1X75=75	1x100=100	1X200=200	4300

Total credits & Marks (semester-1 to 8) for 4-Yr. B.Sc. Honours Without Research Courses of Studies

	DSCC/RM	Minor (2)	IDC	AEC	CVAC	SEC	Summer Internship	Total
Credit	25 X4=100	8X4=32	3X3=9	4x2=8	4x2=8	4X3=12	1X3 =3	172
Marks	25x 100=2500	8X100=800	3X75=225	4c 50=200	4c 50=200	3X100=300	1X75=75	4300

1 credit=25 marks

IDC (PHYD) offered in 1st or 2nd or 3rd Semester, **Summer Internship once after 2nd or 4th or 6th Semester.

Annexure II

Course Structure- 3 yr MDC (NEP 2020)

PHYSIOLOGY

UNIVERSITY OF CALCUTTA

Third Year

Sem		CC1	CC2	Minor	IDC	AEC	CVAC	SEC	Summer Internship	Total Credits
V	Course	MDC CC6 (3TH +1P) Special Senses, Endocrine, Reproductive Physiology	MDC CC6 (3TH +1P) Special Senses, Endo, Repro Physiology	MDC MN3 (3TH +1P) Digestive, Nutrition Diet and Metabolism						20
		MDC CC7 (3TH +1P) Histology, Clinical Biochem, Molecular Biology, Evolution and Biostatistics		MDC MN 4 (3TH +1P) Cardio, Respirat, Nerve-Muscle & Renal Physiology.						
	Credit	8 Credit	4 Credit	8 Credit					-	
VI	Course		MDC CC7 (3TH +1P) Histology, Clinical Biochem, Molecular Biology, Evolution and Biostatistics	MDC MN 5 Special Senses, Endocrine and Reproductive Physiology					Summer Internship	20
		MDC CC8 (3TH +1P) Microbiology, Immuno, Work Sports, Ergonomics and Occupational Health	MDC CC8 (3TH +1P) Microbiology, Immuno, Work Sports, Ergonomics and Occupational Health	MDC MN 6 Micro, Immuno, Work Sports, Ergonomics & Occup. Health						
	Credit	4 Credit	8 Credit	8 Credit					3 Credit **	
Students on exit shall be awarded Three-year B.Sc. with two Core and one Minor after securing the requisite (125 +3**) = 128 credits at the end of Semester VI										40

Total credits & Marks (semester-1 to 6) for 3-Yr. MDC

	CC1	CC2	Minor	IDC	AEC	CVAC	SEC	Summer Internship	Total
Credit	8x4=32	8x4=32	6x4=24	3x3=9	4x2=8	4x2=8	3x4=12	3**	128
Marks	8x100=800	8x100=800	6x100=600	75x3=225	4x50=200	4x50=200	3x100=300	1x=75=75	Total marks= 3200

Marks = 25 marks per credit.

IDC offered in 1st or 2nd or 3rd Semester, **Summer Internship once after 2nd or 4th or 6th Semester. ***SEC to be opted in 1st or 2nd or 3rd Semester.
