



CBCS SYLLABUS
FOR
THREE YEARS UNDER-GRADUATE COURSE
IN
PHYSIOLOGY (HONOURS)
(w.e.f. 2022)



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CONTENTS

SL. No.	Subject Matter	Page No.
1.	Introduction	3
	1.1. Program Outcome (PO)	4
	1.2. Program Specific Outcome (PSO)	5
2.	Scheme for CBCS Curriculum	6 -15
	2.1 Credit Distribution Across Courses	6
	2.2 Scheme for CBCS Curriculum in Physiology (Honours)	7 - 14
	2.3 Choices for Discipline Specific Electives	13
	2.4 Choices of Skill Enhancement Courses	14
	2.5 Choices for Generic Elective Courses	14
	2.6 Question Pattern Across Courses	15
3.	Core Courses (Physiology Honours CC 1 to 14)	16-51
4.	Discipline Specific Elective Courses (DSE 1 to 8)	52-72
5.	Skill Enhancement Courses (SEC 1 to 2)	73-78
6.	Generic Elective Courses (GE 1 to 4)	79-95



1. Introduction

The syllabus for Physiology at undergraduate level using the Choice Based Credit system has been framed in compliance with UGC CBCS Guidelines. The purpose of the course is to standardize physiology teaching at undergraduate level throughout the state.

The main objective of framing this new syllabus is to give the students a holistic understanding of the subject giving substantial weightage to both the core content and techniques used in Physiology.

The course content also lists new practical exercises, so that the students get a hands-on experience of the latest techniques that are in current usage both in the advanced research laboratories and in Industry. The syllabus will equip all undergraduate students with knowledge on basic physiological mechanisms with references to their implications in pathogenesis of disease and the physiological basis of their management.

The revised CBCS curriculum to be implemented from the academic session 2022-2023 conforms to Learning Outcome Based Curriculum Framework (LOCF) and aims at imparting concept-based learning with emphasis on skill development and research. The overall objective of this programme is to enable students to learn and integrate knowledge in different physiological processes involving in system functions of human body. This is relevant to study and understand the complex physiological processes and thus help them for post-graduate education and also to build their careers as academician, research scientist, scientist at the pharmaceutical industry, scientist at the sector of Sports Physiology and also as scientist in the field of Ergonomics and Design.



1.1. Program Outcome (PO)

P.O.1: Students will be enriched about the knowledge covering the functional activities of different physiological systems operating in co-ordinated fashion from molecular and cellular levels to the system levels.

P.O.2: Participants of this course will be empowered by perceiving information about the impact of environmental biotic and abiotic factors for the maintenance of homeostasis of human body.

P.O.3: Learners will be skilled and expertised themselves for doing biophysical and biochemical analysis of human body samples for assessment of health status and dissemination of public health awareness package to the community.

P.O.4: Student will be oriented for cognitive power upgradation and problem-solving activity in different biological deviated conditions in connection with acclimatization to real life situation.

P.O.5: Undergraduate students will capable to achieved integrated and interdependent knowledge among human body activities in collaborative manners with plant and animal kingdom in a holistic fashion.



1.2. Program Specific Outcome (PSO)

Course Objectives

Physiology provides a broad scientific education, which allows our graduates to pursue a career in research work or in related subjects and in areas such as Universities, Research Institute, and the Pharmaceutical Industry, scientific publishing or public health. As a graduate, the students will have a number of direct avenues –

P.S.O1: Will orient the students and attract them for pursuing higher studies in this line and for carrier building in the field of health sector, formal education sector, pharma industries, biotechnological corporates etc.

P.S.O2: Will facilitate the student for fundamental knowledge perception which will drive them to conduct further study in research in the field of allied health sciences, medical sciences, veterinary sciences and others.

P.S.O3: Will support the students for self-dependent learning and understanding to conduct experiments, knowledge bank enrichment and spreading the health awareness information through information-communication-technology.

P.S.O4: This course will provide a sound basis in human physiology to support further study in health and medical sciences or related fields. Development of practical knowledge and skills that is required for pursuing a career in clinical diagnosis, drug design, vaccine development, pharmaceutical industry.

P.S.O5: On working in different designing industry as an Ergonomist, in Defence Research Institute as Scientist and also at the Sports Training Institute as Sports Scientist/Physiologist.



2. Scheme for CBCS Curriculum

2.1 Credit Distribution Across Courses

Course Type	Total Papers	Credits	
		Theory + Practical	Theory*
Core Courses	14	14*4 =56	14*5 =70
		14*2 =28	14*1 =14
Discipline Specific Electives	4	4*4=16	4*5=20
		4*2=8	4*1=4
Generic Electives	4	4*4=16	4*5=20
		4*2=8	4*1=4
Ability Enhancement Language Courses	2	1*2=2 (ENG / MIL) 1*4=4 (ENVS)	1*2=2 (ENG / MIL) 1*4=4 (ENVS)
Skill Enhancement Courses	2	2*2=4	2*2=4
Totals	26	142	142

*Tutorials of 1 Credit will be conducted in case there is no practical component



2.2 Scheme for CBCS Curriculum in Physiology (Honours)

SEMESTER-I

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SH/PHY/ 101/C-1	CT-1: Cellular Basis of Physiology	4	10	25	50	4	NA	4
	CP-1: Cellular Basis of Physiology Lab	2		15				
SH/PHY/ 102/C-2	CT-2: Biophysical Aspects of Cellular Functions and Enzymes	4	10	25	50	4	NA	4
	CP-2: Biophysical Aspects of Cellular Functions and Enzymes Lab	2		15				
SH/PHY/ 103/GE-1	GET-1: Cellular Components, Biophysical and Biochemical Concepts	4	10	25	50	4	NA	4
	GPT-1: Cellular Components, Biophysical and Biochemical Concepts Lab	2		15				
ACSHP/104 /AECC-1	Environmental Studies	4	10	40	50	2	NA	NA
Total in Semester - I		22	40	160	200	14		12

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

**SEMESTER-II**

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SH/PHY/ 201/C-3	CT-3: Physiology of Nerve and Muscle Cells	4	10	25	50	4	NA	4
	CP-3: Physiology of Nerve and Muscle Cells Lab	2		15				
SH/PHY/ 202/C-4	CT-4: Chemistry of Biomolecules	4	10	25	50	4	NA	4
	CP-4: Chemistry of Biomolecules Lab	2		15				
SH/PHY/ 203/GE-2	GET-2: Blood, Cardio-respiratory and Neuromuscular Systems	4	10	25	50	4	NA	4
	GEP-2: Blood, Cardio-respiratory and Neuromuscular Systems Lab	2		15				
ACSHP/204 /AECC-2	English/Hind/MIL	2	10	40	50	2	NA	NA
Total in Semester - II		20	40	160	200	14		12

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

**SEMESTER-III**

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SH/PHY/ 301/C-5	CT-5: Circulating Body Fluids	4	10	25	50	4	NA	4
	CP-5: Circulating Body Fluids Lab	2		15				
SH/PHY/ 302/C-6	CT-6: Circulation	4	10	25	50	4	NA	4
	CP-6: Circulation Lab	2		15				
SH/PHY/ 303/C-7	CT-7: Functions of the Nervous System	4	10	25	50	4	NA	4
	CP-7: Functions of the Nervous System Lab	2		15				
SH/PHY/ 304/GE-3	GET-3: Digestion, Metabolism, Nutrition and Excretion	4	10	25	50	4	NA	4
	GEP-3: Digestion, Metabolism, Nutrition and Excretion Lab	2		15				
SH/PHY/ 305/SEC-1	Any one of the following							
	SECP-1: Detection of Food Adulteration Lab Or SECP-1: Hematological Techniques Lab	2	10	40	50	NA	NA	4
Total in Semester - III		26	50	200	250	16		20

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

**SEMESTER-IV**

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SH/PHY/ 401/C-8	CT-8: Energy Balance, Metabolism and Nutrition	4	10	25	50	4	NA	4
	CP-8: Energy Balance, Metabolism and Nutrition Lab	2		15				
SH/PHY/ 402/C-9	CT-9: Gastrointestinal Physiology	4	10	25	50	4		4
	CP-9: Gastrointestinal Physiology Lab	2		15				
SH/PHY/ 403/C-10	CT-10: Respiratory Physiology	4	10	25	50	4	NA	4
	CP-10: Respiratory Physiology Lab	2		15				
SH/PHY/ 404/GE-4	GET-4: Neurosensory, Endocrine and Reproductive Systems	4	10	25	50	4	NA	4
	GEP-4: Neurosensory, Endocrine and Reproductive Systems Lab	2		15				
SH/PHY/ 405/SEC-2	Any one of the following SECT-1: Clinical Biochemistry Or	2	10	40	50	2	NA	NA
	SECT-1: Clinical Microbiology and Bio-Medical Technology							
Total in Semester - IV		26	50	200	250	18		16

N.B. Theory: 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

**SEMESTER-V**

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SH/PHY/ 501/C-11	CT-11: Special Senses	4	10	25	50	4	NA	4
	CP-11: Special Senses Lab	2		15				
SH/PHY/ 502/C-12	CT-12: Endocrinology	4	10	25	50	4	NA	4
	CP-12: Endocrinology Lab	2		15				
SH/PHY/ 503/DSE-1	Any one of the following	4	10	25	50	4	NA	4
	DSET-1: Biostatistics and Computer Application							
	DSEP-1: Biostatistics and Computer Application Lab	2		15				
	Or							
	DSET-1: Human Nutrition and Dietetics							
	DSEP-1: Human Nutrition and Dietetics Lab							
SH/PHY/ 504/DSE-2	Any one of the following	4	10	25	50	4	NA	4
	DSET-2: Microbiology and Immunology							
	DSET-2: Microbiology and Immunology Lab	2		15				
	Or							
	DSET-2: Genetics and Molecular Biology							
	DSEP-2: Genetics and Molecular Biology Lab							
Total in Semester – V		24	40	160	200	16		16

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

**SEMESTER–VI**

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SH/PHY/ 601/C-13	CT13: Reproduction	4	10	25	50	4	NA	4
	CP13: Reproduction Lab	2		15				
SH/PHY/ 602/C-14	CP14: Excretion, Skin and Body Temperature Regulation	4	10	25	50	4	NA	4
	CP14: Excretion, Skin and Body Temperature Regulation Lab	2		15				
SH/PHY/ 603/DSE-3	Any one of the following							
	DSET-3: Ergonomics and Occupational Physiology	4	10	25	50	4	NA	4
	DSEP-3: Ergonomics and Occupational Physiology Lab	2		15				
	Or							
	DSET-3: Environmental Physiology and Toxicology							
	DSEP-3: Environmental Physiology and Toxicology Lab							
SH/PHY/ 604/DSE-4	Any one of the following							
	DSET-4: Sports and Exercise Physiology	4	10	25	50	4	NA	4
	DSEP-4: Sports and Exercise Physiology Lab	2		15				
	Or							
	DSET-4: Nanobiotechnology and Bioinformatics [* In case of DSET-4 (Or) Lecture hour = 18]	6	10	40	50	6	NA	NA
Total in Semester – VI		24	40	160	200	16*		16

SC = Subject Code, C= Core Course, AECC= Ability Enhancement Compulsory Course, SEC= Skill Enhancement Course, GE= Generic Elective, DSE= Discipline Specific Elective IA= Internal Assessment, ESE= End-Semester Examination, Lec.=Lecture, Tu.= Tutorial, and Prc.=Practical



2.3 Choices for Discipline Specific Electives

SEMESTER	COURSE	CHOICE
V	DSE-1	DSET-1: Biostatistics and Computer Application DSEP-1: Biostatistics and Computer Application Lab OR DSET-1: Human Nutrition and Dietetics DSEP-1: Human Nutrition and Dietetics Lab
	DSE-2	DSET-2: Microbiology and Immunology DSEP-2: Microbiology and Immunology Lab Or DSET-2: Genetics and Molecular Biology DSEP-2: Genetics and Molecular Biology Lab
VI	DSE-3	DSET-3: Ergonomics and Occupational Physiology DSEP-3: Ergonomics and Occupational Physiology Lab Or DSET-3: Environmental Physiology and Toxicology DSEP-3: Environmental Physiology and Toxicology Lab
	DSE-4	DSET-4: Sports and Exercise Physiology DSEP-4: Sports and Exercise Physiology Lab Or DSET-4: Nanobiotechnology and Bioinformatics



2.4 Choices of Skill Enhancement Courses

SEMESTER	COURSE	CHOICE
III	SEC1	SECP-1: Detection of Food Adulteration Lab Or SECP-1: Hematological Techniques Lab
IV	SEC2	SECT-1: Clinical Biochemistry Or SECT-1: Clinical Microbiology and Bio-Medical Technology

2.5 Choices for Generic Elective Courses (GE)

SEMESTER	COURSE	CHOICE
I	GE1	GET1: Cellular Components, Biophysical and Biochemical Concepts GEP1: Cellular Components, Biophysical and Biochemical Concepts Lab
II	GE2	GET2: Blood, Cardio-respiratory and Neuromuscular Systems GEP2: Blood, Cardio-respiratory and Neuromuscular Systems Lab
III	GE3	GET3: Digestion, Metabolism, Nutrition and Excretion GEP3: Digestion, Metabolism, Nutrition and Excretion Lab
IV	GE4	GET4: Neurosensory, Endocrine and Reproductive Systems GEP4: Neurosensory, Endocrine and Reproductive Systems Lab



2.6 Question Pattern Across Courses

Question Pattern								
Examination	Course type (Honours)	Credits (Theory+ Practical)	Type of questions	Marks/ question	No of questions to be attempted	Total	No of options (Out of)	
	Total Marks (Theoretical)					25		
	CC (H), DSE (H), GE (H),	4	Objective	1	5	5	8	
			Short	5	2	10	4	
			Broad	10	1	10	2	
	Total Marks (Theoretical)					40		
	SEC (H)	2	Very short	2	5	10	8	
			Short	5	4	20	6	
			Broad	10	1	10	2	
	Total Marks (Practical)					15		
	CC (H), DSE (H), GE (H),	2	Practical work	10	Answer all the question	10	N A	
			Laboratory Note Book	3		3	N A	
			Viva Voce	2		2	N A	
	Total Marks (Practical)					40		
	SEC (H)	2	Practical work	10	3	30	3	
			Laboratory Note Book	5	NA	5	N A	
			Viva Voce	5	NA	5	N A	

Duration of Examinations

Subject and Type of Papers	Full Marks	Duration
Honours (Theoretical)	25	1 Hour 15 Minutes
Honours (Theoretical)	40	2 Hours
Honours (Practical)	15	2 Hours
Honours (Practical)	40	4 Hours

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3. CORE COURSES



SEMESTER-I

3.1 Core T1 – Cellular Basis of Physiology

Course Code: SH/PHY/101/C-1

Course ID: 12511

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] 4 Credits

Course Learning Outcomes:

- This course gives a wide knowledge about structure and functions of cell organelle.
- From this course students will gather the knowledge about the cell, tissue, organ and systems.
- The course would fortify to the students to acquire the knowledge about transport across cell membranes and intracellular communications.
- They acquire a concept about cell cycle, cell division, homeostasis and aging process.

Unit 1

1. Introduction
2. Body Fluid Components – Blood, lymph, tissue fluid, CSF, synovial fluid (Source, composition and function).
3. Organ Systems and Tissues – General classification, special emphasis on connective tissue, areolar tissue and cells - Ciliated epithelium and glandular cells.
4. Structure and Function of Cell Organelle – Plasma membrane, nucleus, mitochondria, ribosome, lysosome, Golgi body, endoplasmic reticulum, peroxisomes, cytoskeletal elements and centrosomes.
5. Transport Across Cell Membranes - Active, passive, carrier mediated, antiport and symport.
6. Intercellular Communication – Gap junction, tight junction, intercalated disc, desmosomes and cell adhesion molecules. Extracellular matrix components.

Unit 2

1. Cell Cycle – Definition, different phases of cell cycles, regulation and check points of cell cycle.
2. Apoptosis and Necrosis - Basic concept and mechanism.
3. Cell division
 - a. Mitosis – Phases and significance.
 - b. Meiosis – Phases and significance.
 - c. Special emphasis on homologous, heterologous, chiasma formation, crossing over, recombination and disjunction of chromosome.
4. Homeostasis – General concept, feedback and feedforward regulatory mechanism of Homeostasis.
5. Aging – Etiology, theories of aging, metabolic changes and management.



3.2 Core P1 – Cellular Basis of Physiology Lab

Course Code: SH/PHY/101/C-1

Course ID: 12521

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

Course Learning Outcomes:

- From this course students will gather their knowledge about various parts of microscope.
- This practical course will provide wide range of knowledge about histological structure of different organs and glands.
- They will gather knowledge about structural morphology of different types of fresh tissue.

1. Introduction on: Principle, working procedure and function of different components of microscope.
2. Introduction on permanent slides - Applied value.
3. Study and identification of stained sections of different mammalian tissues and organs: Bone, cartilage, trachea, lungs, spleen, lymph gland, esophagus, stomach, duodenum, ileum, jejunum, large intestine, liver, kidney, ureter, salivary glands, pancreas, adrenal gland, thyroid gland, testes, ovary, spinal cord, cerebral cortex, cerebellum, skin, cardiac muscle, skeletal muscle, smooth muscle, artery, vein, tongue and uterus.
4. Examination and staining of fresh tissues squamous, ciliated and columnar epithelium by methylene blue stain.
5. Staining of adipose tissue using Sudan III or IV.



3.3 Core T2 – Biophysical Aspects of Cellular Functions and Enzymes

Course Code: SH/PHY/102/C-2

Course ID: 12512

[Theory: Credits 4 (4 Lectures /Week)/ Marks 25]

Course Learning Outcomes:

- The learner will gather knowledge about biophysical principles of living systems.
- From this course students will acquire the knowledge about enzyme kinetics and inhibitions.
- The course would enrich the students to gain the knowledge colloids and different types of chemical bonds.
- This course will provide wide range of knowledge about thermodynamic principles.
- Students will enrich from this core course about chromatography.

Unit 1

1. Study of Units for Measuring Concentration of Solutes: Normality, moles, equivalents, osmoles.
2. Principles of dilution.
3. Acids and Bases: Acidosis, alkalosis, tolerance level of acidosis, alkalosis and normal homeostasis.
4. pH and Buffer - Henderson Hasselbalch equation (quantitative problems). Definition of pH, Determination of pH, Buffer and operating principle of buffer (Brief idea).

Unit 2

1. Bonds and forces in biomolecules.
2. Colloids - Definition, types, properties, importance, protective colloid and gold number.
3. Osmosis and Diffusion – Definition, process in brief and physiological importance.
4. Surface Tension, Specific Gravity – Definition, process in brief and physiological importance.
5. Viscosity and Resistance – Definition and physiological importance.
6. Flow and Pressure – Biophysical aspect and physiological importance
 - a. Laminar and Streamline flow
 - b. Poiseuille-Hagen Formula
 - c. Laws of Laplace
7. Dialysis and Ultracentrifugation – Definition, principle, mechanism in brief and application.
8. Chromatography - Definition, principle, applied value of major types (Paper Chromatography and TLC) and HPLC (in brief).



Unit 3

1. Electrophoresis – Gel, SDS-Page - Definition, principle and applied value.
2. Autoradiography - Definition, principle and applied value.
3. Cell Fractionation and Tracer Techniques – Process and applied value.
4. Nanoparticles and its application in Physiology.
5. Thermodynamics -1st Law, 2nd Law, entropy, enthalpy, Gibbs free energy - General concept and application in human body. Endergonic and exergonic reactions, reversible and irreversible processes, equilibrium constant. Physiological steady state and Living body as a thermodynamic system.

Unit 4

1. A study of Enzymes:
 - a. Definition, apo-enzyme, holoenzyme, co-enzyme, properties and classification; isoenzymes, ribozymes and abzymes.
 - b. Mechanism of enzyme action.
 - c. Factors regulating enzyme activities.
 - d. Kinetics – Hyperbolic and sigmoid kinetics; Michaelis constant.
 - e. Enzyme inhibition-Competitive, non-competitive and uncompetitive.
 - f. Allosteric modulation of enzymes activities.
 - g. Concept of rate limiting enzymes – Definition and features.



3.4 Core P2 – Biophysical Aspects of Cellular Functions and Enzymes Lab

Course Code: SH/PHY/102/C-2

Course ID: 12522

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

Course Learning Outcomes:

- Students will develop their knowledge about measurement of blood pressure and its importance.
- They will improve their knowledge on determination of antioxidant enzymes and their role on living system.
- The course would fortify to the students to acquire the knowledge about how to measure the viscosity and oncotic pressure of colloidal solution.

1. Determination of systolic, diastolic, pulse and mean blood pressure by non-invasive method (Auscultatory Method).
2. Determination of enzyme activities (e.g., SOD, CAT, amylase and transaminases).
3. Preparation of buffer solution (Phosphate buffer and bi-carbonate buffer) and pH measurement.
4. Determination of viscosity of glycerol and sugar solution in respect to water.
5. Demonstration of oncotic pressure of colloidal solutions.

Suggested Readings

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11. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
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21. Masanta N and Das T. (2019) Snatak Sarirbidya. (UG CBCS syllabus) Vol II. Santra Publication Pvt. Ltd.
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23. Note Books on Practical Biochemistry. Published by The Physiological Society of India. Kolkata.
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25. Debnath, J. Byabaharik Sharir Bignan. Shreedhar Prokashani, Kolkata.
26. Pal, G.K. Pal, P. (2013). Textbook of Practical Physiology. Third Edition. Universities. Press.



SEMESTER-II

3.5 Core T3 – Physiology of Nerve and Muscle Cells

Course Code: SH/PHY/201/C-3

Course ID: 22511

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25]

4 Credits

Course Learning Outcomes:

- Students will develop their knowledge on structure and function of muscle, nerve, synapse and neuromuscular junction.
- From this core paper they will learn the properties of muscle and nerve and mechanism of muscle contraction.
- This core course will provide knowledge about receptors and their function.

Excitable Tissue: Nerve

1. Introduction
2. Nerve Cells – Types, structure and function of neuron.
3. Glial Cells - Types, structure and function.
4. Properties of nerve cell and myelinogenesis.
5. Action potential, phases and ionic basis of action potential.
6. Conduction of nerve impulse in myelinated and nonmyelinated nerve fibre.
7. Nerve Fiber - Types and function, degeneration and regeneration of nerve fibre.
8. Neurotrophins – Definition, chemical nature and function.

Excitable Tissue: Muscle

1. Introduction – Etiology of specific type of muscle, classification and general function.
2. Skeletal Muscle
 - a. Morphology – Structure and function.
 - b. Properties of muscle in the intact organism.
 - c. Mechanism of contraction.
 - d. Electrical phenomena and ionic fluxes.
 - e. Energy sources and metabolism.
3. Cardiac Muscle
 - a. Morphology – Structure and function.
 - b. Properties of cardiac muscle.
 - c. Metabolism
4. Smooth Muscle
 - a. Morphology – Structure, properties and function.
 - b. Single unit and multi-unit smooth muscle.
 - c. Mechanism of contraction.



Synaptic and Junctional Transmission

1. Introduction
2. EM structure of central and peripheral synapse.
3. Properties of synapse.
4. Synaptic transmission.
 - a. Electrical events at synapses.
 - b. Chemical transmission of synaptic activity.
 - c. Synaptic plasticity and learning – in brief.
 - d. Neurotransmitter – Types; mode of action of cholinergic and adrenergic substance.
5. Neuromuscular Transmission.
 - a. Neuromuscular junction – Anatomy, mechanism of signal transduction and function.
 - b. Applied aspects – Myasthenia Gravis and Lambert-Eaton syndrome.
 - b. Denervation hypersensitivity in brief.

Receptor

1. Introduction
2. Receptors – Definition, biotransducers, classification and functions, receptor potential.
3. Electrical and ionic events in Pacinian corpuscle.



3.6 Core P3 – Physiology of Nerves and Muscle Cells Lab

Course Code: SH/PHY/201/C-3

Course ID: 22521

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

Course Learning Outcomes:

- This course gives a wide knowledge about different parts of kymograph, induction coil and their functions.
- From this course students will develop their skill on staining of nerve and muscle fibres for microscopic observation.
- Learner will increase their ability to prepare nerve muscle preparation and study about different mechanical events of muscle contraction.

1. Study of kymograph, induction coil, key and other instruments used to study mechanical responses of skeletal muscle.
2. Isolation and staining of node(s) of Ranvier (AgNO_3 method) and muscle fibers (Using methylene blue).
3. Preparation of gastrocnemius-sciatic nerve and muscle of toad.
4. Kymographic recording of simple muscle curve of toad.
5. Kymographic recording of hot and cold saline on isolated nerve muscle preparation of toad.
6. Calculation of Latent period, contraction period, relaxation period, maximum height of contraction from the kymographic recording of simple muscle curve of toad and interpret your result.



3.7 Core T4 – Chemistry of Biomolecules

Course Code: SH/PHY/202/C-4

Course ID: 22512

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] 4 Credits

Course Learning Outcomes:

- Students will improve their knowledge about structure and functions of biomolecules.
- This core paper will enrich our students about different structure of protein and their importance.
- From this core course learner will gain their knowledge about nucleic acid chemistry and central dogma.

A. Introduction on biomolecules and its importance on human system.

B. Carbohydrates

1. Classification of carbohydrates.
2. Structure of carbohydrates.
3. Properties of carbohydrates.
4. Functions of carbohydrates.

C. Proteins

1. Classification of proteins.
2. Structure of proteins.
3. Properties of proteins.
4. Functions of proteins.
5. Amino acid - Classification and properties.

D. Lipids

1. Classification of lipids.
2. Structure of lipids.
3. Properties of lipids.
4. Functions of lipids.

E. Nucleic acids

1. Purine and pyrimidine: Structure, nomenclature and tautomerism.
2. Nucleic acids: Nucleosides and nucleotides - Structure.
3. Structure, types and function of DNA.
4. Structure, types and function of RNA.
5. DNA replication, transcription and translation.



3.8 Core P4 – Chemistry of Biomolecules Lab

Course Code: SH/PHY/202/C-4

Course ID: 22522

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

Course Learning Outcomes:

- This course will enrich the students about qualitative assessment of physiologically important biomolecules.
- From this core course learner will develop their knowledge about clinical aspects of biomolecules.

1. Introduction of qualitative assessment of physiologically important biomolecules.
2. Qualitative tests for the identification of physiologically important substances: Hydrochloric acid, lactic acid, uric acid, glucose, galactose, fructose, sucrose, lactose, albumin, gelatin, peptone, starch, dextrin, urea, glycerol and bile salts - Systematic analysis and confirmatory test.

Suggested Readings

1. Mahapatra, A.B.S. (2014). Essentials of Medical Physiology. Forth Edition. Current Books International.
2. Sembulingam, K. and Sembulingam, P. (2016). Essentials of Medical Physiology 7th Edition. Jaypee.
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6. Das, D. (2008). Biochemistry. Academic Publishers.
7. Upadhyay, Upadhyay, Nath. Biophysical Chemistry. Himalaya Publishing House.
8. Nelson D.L and Cox M.M. (2017) Lehninger Principles of Biochemistry, 7th Edition., W.H. Freeman and Company.
9. Campbell, M.K. (2012) Biochemistry, 7th ed., Published by Cengage Learning.
10. Satyanarayana, U. and Chakrapani. U. (2013). Biochemistry. 4th Edition. Elsevier India.
11. Core Text Book of Neuro-Anatomy, by M.B.Carpenter: the Williams and Wilkins Company.
12. Berg, J.M. (Author), Tymoczko, J.L. Stryer, L. (2006). Biochemistry: International Edition
13. Charles Nobach .The Human Nervous System. Mc Graw Hill Book Co.
14. Berne , R.M. and Levy M.N. Physiology. C.V.Mosby Co.
15. Pal, G.K. Pal, P. (2013). Textbook of Practical Physiology. Third Edition. Universities. Shepherd.G.M. Neurobiology. Oxford University Press.
16. Chadha, P.V. Handbook of Experimental Physiology and Biochemistry. Jaypee Brothers Medical Publishers.
17. Debnath, J. Byabaharik Sharir Bignan. Shreedhar Prokashani, Kolkata.
18. Murray, R.K. Granner, D.K. Mayes, P.A. Rodwell, V.W. (2000). Harper's Biochemistry. 25th Edition. McGraw-Hill.
19. Voet, D and Voet, J.G. (2004). Biochemistry. 3rd Edition. Hohn Wiley and Sons Inc.23. Note Books on Practical Biochemistry. Published by The Physiological Society of India. Kolkata.
20. Note Books on Practical Histology. Published by The Physiological Society of India. Kolkata.

**SEMESTER–III****3.9 Core T5 - Circulating Body Fluids****Course Code: SH/PHY/301/C-5****Course ID: 32511****[Theory: Credits 4 (4 Lectures/Week)/ Marks 25]****4 Credits*****Course Learning Outcomes:***

- From this course students will gain the knowledge about blood and its components.
- This course will enrich the learner about the morphology, classification and important function of formed elements.
- Student will acquire the knowledge on hemostatic mechanism and the clinical aspects of blood coagulation.
- The students will gain their knowledge on blood group, blood transfusion and its related health hazards.

1. Introduction
2. Blood – Components and general function.
3. Plasma - Composition and function.
4. Plasma proteins - Origin, synthesis, classification and function.
5. Blood volume and measurement of blood volume.
6. Bone Marrow – Red and yellow.
7. Red Blood Cells – Erythropoiesis; hemoglobin-types, synthesis and fate.
8. Brief idea on Anaemia, polycythemia and hemoglobinopathies.
9. Brief idea on MCV, MCH, MCHC and colour index.
10. White Blood Cells – Morphology, classification, life cycles, functions, Human leucocyte antigen (HLA). Leucopoiesis, Arneht index.
11. Platelets - Formation and fate.
12. Hemostasis – Definition, factors, modern concept and abnormalities in hemostasis. Anti-coagulants used in different purposes.
13. Blood Types – Group and Rh typing. Cross matching (Major and minor cross matching), blood transfusion and transfusion related hazards
14. Lymph – Formation, circulation and function.
15. Separation of different components of blood in blood bank and their clinical importance.



3.10 Core P5 – Circulating Body Fluids Lab

Course Code: SH/PHY/301/C-5

Course ID: 32521

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

Course Learning Outcomes:

- The course content will develop skill of our students on hematological techniques.
- Student will gain the knowledge on total count of RBC and WBC.
- They will increase their skill on blood film preparation and staining procedure.
- Student will develop their knowledge on blood group detection and Rh typing.

1. Preparation and staining of blood film with Leishman's stain and identification of blood cells.
2. Differential count of WBC.
3. Total count of RBC and WBC.
4. Bleeding time and clotting time.
5. Hemoglobin estimation by Sahli's method.
6. Preparation of haemin crystal.
7. Preparation and staining of bone marrow and different stages of erythropoiesis.
 - a. Measurement of diameter of megakaryocyte.
8. Reticulocyte staining.
9. Blood group determination and Rh typing.



3.11 Core T6 – Circulation

Course Code: SH/PHY/302/C-6

Course ID: 32512

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25]

4 Credits

Course Learning Outcomes:

- Student will be able to learn about structure and function of cardiovascular system.
- From this course learners will gather knowledge about origin and spread of cardiac impulse along with properties of cardiac muscle.
- They will acquire their knowledge about the electrocardiogram and its clinical correlation with different cardiac abnormalities.
- This core paper will enrich our students about hemodynamics and blood pressure.
- From this core course learner will gain their knowledge about different regional circulation with peculiarities.

Origin of the Heart Beat and the Electrical Activity of the Heart

1. Introduction
2. Special junctional tissues – Location, structure and function.
3. Origin and spread of cardiac impulse and pacemaker potential.
4. The Electrocardiogram – Leads, Einthoven Law, Einthoven triangle, normal waves and their significances. Mean electrical axis of heart.
5. Electrocardiographic findings in some cardiac and systemic diseases (Myocardial ischemia, heart block, atrial and ventricular fibrillation) and Cardiac arrhythmias.
6. Diagnosis of cardiac diseases by analysis of blood sensors: Troponin C.

The Heart as a Pump

1. Introduction
2. Mechanical events of the cardiac cycle, heart sound, volume and pressure change.
3. Cardiac Output - Definition, types, factors affecting, regulation and measurement.

Dynamics of Blood and Lymph Flow

1. Introduction
2. Anatomic and biophysical considerations of
 - a. Arterial and arteriolar circulation.
 - b. Capillary circulation.
 - c. Lymphatic circulation and interstitial fluid volume.
 - d. Venous circulation.
3. Blood Pressure – Definition, types, measurement and regulation.



Cardiovascular Regulatory Mechanisms

1. Introduction
2. Local regulatory mechanisms.
3. Substances secreted by the endothelium.
4. Systemic regulation by hormones and nervous system.

Circulation Through Special Regions

1. Introduction
2. Cerebral circulation
 - a. Anatomic considerations
 - b. Peculiarities
 - c. Cerebral blood flow measurement and regulation
 - d. Circulation of CSF
 - e. Brain metabolism and oxygen requirements.
 - f. The Blood-Brain Barrier.
3. Anatomy, regulation and peculiarities of
 - a. Coronary circulation.
 - b. Splanchnic circulation.
 - c. Circulation of the skin.
 - d. Placental and fetal circulation.

Cardiovascular Homeostasis in Health & Disease

1. Introduction
2. Compensation for gravitational effects.
3. Exercise.
4. Inflammation and wound healing (in brief).
5. Atherosclerosis.
6. Shock (in brief).
7. Hypertension (in brief).
8. Heart Failure and Stroke (in brief).



3.12 Core P6 – Circulation Lab

Course Code: SH/PHY/302/C-6

Course ID: 32522

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

Course Learning Outcomes:

- The students will be aware on accuracy in artificial fluid preparation with the importance of components in experimental animal as toad.
- They will increase their skill on perfusion experiment using cholinergic and adrenergic drugs partnering cardiac activities of toad.
- Student will be able to gather preliminary idea on ECG recording and interpretation through demonstration model.

1. Introduction and preparation of Amphibian Ringer solution.
2. Kymographic recording of the normal heart beat of toad.
3. Effect of adrenaline and acetyl choline on perfused heart of toad.
4. Computation of HR, PQ interval, QRS complex, PR interval from supplied ECG recording graph.



3.13 Core T7 - Functions of the Nervous System

Course Code: SH/PHY/303/C-7

Course ID: 32513

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25]

4 Credits

Course Learning Outcomes:

- From this core course students will gain their knowledge about elementary ideas on CNS, PNS and ANS.
- They will have specific knowledge on human body's reflexogenic activities and their control measures.
- The learner will get information regarding various central nervous system components, their integrating mechanism of action as well as abnormal neural function.
- The students will gain their knowledge on higher function of nervous system and reasons of behavioral scenario.

Elementary Idea on Brain and Spinal Cord

1. Structural organization of different parts of brain and spinal cord.

Reflexes

1. Introduction of Reflex - Conditioned, unconditioned, mono synaptic, disynaptic and poly synaptic. Reflex arc - Component.
2. Monosynaptic reflexes: The stretch reflex.
3. Polysynaptic Reflexes: The withdrawal reflex.
4. General properties of reflexes.

Cutaneous, Deep & Visceral Sensory and Motor Pathways.

1. Ascending and descending tracts: Origin, course, termination and functions.
2. Functions of the spinal cord with special reference to functional changes- Following hemisection and complete section of spinal cord.
3. Pain production, perception, regulation, pain pathway and Gate control theory. Referred pain.

Structure and Functions of Different Parts of the Brain

1. Introduction
2. The reticular formation and the reticular activating system.
3. Cerebral Cortex – Structure, important areas and their function.
4. Evoked cortical potentials.
5. The Electroencephalogram.
6. Physiological basis of the EEG, consciousness and sleep.
7. Interpretation of abnormal EEG pattern.



8. Thalamus- Structure, neural connection, function and abnormalities.

Control of Posture and Movement

1. Introduction
2. Role of cerebellum, basal ganglia and vestibular apparatus (In brief).
3. Movement disorders.

The Autonomic Nervous System

1. Introduction
2. Anatomic organization of autonomic outflow.
3. Chemical transmission at autonomic junctions.
4. Responses of effector organs to autonomic nerve impulses.
5. Cholinergic and adrenergic discharge.

Central Regulation of Visceral Function

1. Introduction
2. Medulla oblongata.
3. Hypothalamus
 - a. Anatomic considerations.
 - b. Nuclear organization, connection and function.

Neural Basis of Instinctual Behaviour and Emotions

1. Introduction
2. Anatomic consideration of limbic system.
3. Limbic system in sexual behavior, fear and rage phenomenon.

Higher Functions of the Nervous System

1. Introduction
2. Learning – General concept; Memory – Short term and long term
3. Functions of the neocortex.
4. Disorders relating learning and memory.



3.14 Core P7 – Functions of the Nervous System Lab

Course Code: SH/PHY/303/C-7

Course ID: 32523

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15]

2 Credits

Course Learning Outcomes:

- The learner will enhance their skill through various reflex related functioning of human body with their normal and abnormal interpretation.
- They will increase their skill on upper extremity muscular strength.
- Student will be able to gather accurate idea on short term memory retaining capacity testing and on visual acuity of individual learner.

1. Experiments on superficial (Plantar) and deep (Knee Jerk) reflex.
2. Measurement of hand grip strength.
3. Reaction time by stick drop test.
4. Short term memory test (Shape and picture word).
5. Two point discrimination test.

Suggested Readings:

1. Chatterjee, C.C. (2016). Human Physiology Volume 1. Eleventh Coloured Edition. CBS. Publishers and Distributors Pvt. Ltd.
2. Hall J.E. (2016).
3. Mahapatra, A.B.S. (2014). Essentials of Medical Physiology. Fourth Edition. Current Books International.
4. Sembulingam, K. and Sembulingam, P. (2016). Essentials of Medical Physiology 7th Edition. Jaypee.
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8. Charles Nobach. The Human Nervous System. Mc Graw Hill Book Co.
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10. Guyton, A.C. Hall, J.E. (2007) Text Book of Medical Physiology. Eleventh Edition. W.B. Saunders Co.
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13. Chadha, P.V. Handbook of Experimental Physiology and Biochemistry. Jaypee Brothers Medical Publishers.
14. Debnath J. Byabharik Sharir Bignan. Shreedhar Prokashani, Kolkata.

**SEMESTER-IV****3.15 Core T8 - Energy Balance, Metabolism, and Nutrition****Course Code: SH/PHY/401/C-8****Course ID: 42511****[Theory: Credits 4 (4 Lectures/Week)/ Marks 25]****4 Credits*****Course Learning Outcomes:***

- From this core course student will learn about energy balance along with redox potential.
- Learner will also gain their knowledge about intracellular biochemical events in relation with carbohydrate, protein and fat metabolism.
- Student will be able to gather preliminary idea on human nutrition, physiological importance of vitamins and minerals.

1. Introduction
2. Energy metabolism.
3. Redox potential. Mitochondrial electron transport chain. Oxidative phosphorylation - Inhibitors and uncouplers.
4. Carbohydrate metabolism – Glycolysis, Krebs Cycle, glycogenesis, glycogenolysis, neoglucogenesis, HMP Shunt and Cori cycle and their regulations.
5. Protein metabolism – Deamination, transamination, ornithine cycle and protein synthesis.
6. Fat and cholesterol metabolism – Beta-oxidation, omega-oxidation, ketogenesis, fatty acid synthesis and cholesterol synthesis.
7. Integration of carbohydrate, fat and protein metabolism.
8. Purines and Pyrimidines – Biosynthesis: de novo and salvage pathways. Catabolism.
9. Nutrition – BMR, RQ, RDA, SDA, NPU, Biological value of proteins, vitamins and minerals – Brief idea.



3.16 Core P8 - Energy Balance, Metabolism, and Nutrition Lab

Course Code: SH/PHY/401/C-8

Course ID: 42521

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15]

2 Credits

Course Learning Outcomes:

- This course will help to increase the knowledge of our student about colorimetry.
- Lerner will develop their skill on quantitative estimations of biologically important molecules.
- They will also gain their knowledge about clinical importance of biomolecules.

Biochemical Estimation

1. Introduction on colorimetric study.
2. Quantitative estimation of glucose and sucrose by Benedict's method - Percentage and total quantity.
3. Quantitative estimation of amino nitrogen (Sorensen's Formol titration method) - Percentage and total quantity.
4. Estimation of percentage quantity of lactose in milk by Benedict's method.



3.17 Core T9 - Gastrointestinal Physiology

Course Code: SH/PHY/402/C-9

Course ID: 42512

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25]

4 Credits

Course Learning Outcomes:

- From this core course students will gain their knowledge about elementary ideas on different parts of gastrointestinal tract, liver, gall bladder and biliary system.
- They will get detail knowledge on digestion and absorption of carbohydrate, protein and lipid.
- The learner will know about normal microbial flora and their clinical importance.

Gastrointestinal structure

1. Introduction
2. Anatomy and histology of alimentary canal.
 - a. Gastrointestinal hormones.
 - b. Mouth and esophagus and stomach.
 - c. Exocrine portion of the pancreas.
 - d. Liver and biliary system.
 - e. Small intestine.
 - f. Colon.
 - g. Gastrointestinal motility and function.

Digestion and Absorption

1. Introduction
2. Carbohydrates.
3. Proteins and nucleic acids.
4. Lipids.
5. Absorption of water and electrolytes.
6. Absorption of vitamins and minerals.

Normal microbial flora

General introduction of intestinal microbiota.

1. Brief ideas about prebiotics and probiotics and their clinical importance.



3.18 Core P9 – Gastrointestinal Physiology Lab

Course Code: SH/PHY/402/C-9

Course ID: 42522

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

Course Learning Outcomes:

- The learner will get knowledge about preparation of Dale's fluid.
- They will enhance their ability on recording of normal intestinal movement of rat in Dale's bath.
- Student will gain knowledge about effects of hypoxia, acetylcholine and adrenaline on normal intestinal movements.

1. Introduction on Dale's apparatus and preparation of Dale's fluid.
2. Kymographic recording of normal movements of rat's intestine in Dale's apparatus.
3. Effects of hypoxia, acetylcholine and adrenaline on normal intestinal movements of rat.



3.19 Core T10 – Respiratory Physiology

Course Code: SH/PHY/403/C-10

Course ID: 42513

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25]

4 Credits

Course Learning Outcomes:

- From this core course students will get knowledge about pulmonary function and gaseous exchange.
- They will gather specific knowledge on regulation of breathing.
- The students will gain their knowledge about clinical aspects of breathing.

Pulmonary Function

1. Introduction
2. Properties of gases.
3. Anatomy of the lungs.
4. Breathing – Mechanism, mechanics, resistances of breathing, surfactant and compliance.
5. Gas Exchange in the lungs.
6. Pulmonary circulation.
7. Other Functions of the respiratory system – Excretory, body defense function of lungs And pulmonary buffers.

Gas Transport Between the Lungs and the Tissues

1. Introduction
2. Oxygen transport – Mechanism, dissociation curve and factor regulating it.
3. Carbon Dioxide Transport – Mechanism, dissociation curve and factor regulating it.
4. Respiratory acidosis and alkalosis.

Regulation of breathing

1. Introduction
2. Neural control of breathing – Respiratory center and respiratory reflexes.
3. Chemical control of breathing.
4. Non-chemical influences on breathing – in brief

Breathing Adjustments in Health and Disease

1. Introduction
2. Effects of exercise.
3. Types of hypoxia.
4. Oxygen therapy.
5. Hypercapnia and hypocapnia.
6. Other respiratory abnormalities (Mountain sickness, apnoea, dyspnoea, dysbarism, Chyney Stroke Breathing and HAPO).
7. Effects of increased barometric pressure – Caisson disease etc.
8. Artificial breathing – Methods in brief and significance.



3.20 Core P10 – Respiratory Physiology Lab

Course Code: SH/PHY/403/C-10

Course ID: 42523

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15]

2 Credits

Course Learning Outcomes:

- The learner will enhance their skill on lung function test.
- From this core course they will learn how to measure oxygen saturation of blood.
- Student will be able to increase their skill on pneumographic recording of chest movement during different types of physical activities.

1. Measurement of peak expiratory flow rate.
2. Measurement of tidal volume and vital capacity.
3. Pneumographic recording of chest movement: Effect of swallowing, hyperventilation, coughing, reading and laughing and breath holding.
4. Measurement of oxygen saturation by pulse oxymeter before and after exercise.
5. Measurement of forced expiratory volume (FEV) in first second and first 10 second.
6. Demonstration on digital spirometer for lung function test (PFT).

Suggested Readings:

1. Srilakshmi, B. (2016). Nutrition Science. Fifth Edition. New Age International Publishers.
2. Srilakshmi, B. (2014). Dietetics. Seventh Edition. New Age International Publishers.
3. Das S. Textbook of Normal and Therapeutic Nutrition. Academic Publishers.
4. Das S. (2016).Textbook of Community Nutrition. 2nd Edition. Academic Publishers.
5. Basu, P. Nutritional Biochemistry. Academic Publishers.
6. Srilakshmi, B. (2015). Food Science. Sixth Edition. Age International Publishers.
7. Swaminathan, M. (2012). Handbook of Food and Nutrition. Jain Book Agency.
8. Swaminathan, M. (2015). Essentials of Food and Nutrition. Vol. I AND Vol. II. The Bangalore Printing and Publishing Co., Ltd.
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22. Hinkle, J.L. Kerry H. Cheever, K.H. (2013). Brunner & Suddarth's Handbook of Laboratory and Diagnostic Tests. 2nd Edition. LWW Publisher.
23. Godkar, P.B. Godkar. O.D. (2014). Textbook of Medical Laboratory Technology. 14th Edition.

**SEMESTER–V****3.21 Core T11 - Special Senses**

Course Code: SH/PHY/501/C-11

Course ID: 52511

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25]

4 Credits

Course Learning Outcomes:

- From this core course students will gain their knowledge about elementary ideas on visual process, photochemical changes of retina and errors in visual process.
- They will gather specific knowledge about auditory pathway and equilibrium of hearing process.
- The students will also know about the physiology behind smell and taste perception.

Vision

1. Introduction
2. Anatomic considerations of eye.
3. Histological structure of retina.
4. The Image forming mechanism (accommodation and visual acuity), light adaptation and dark adaptation.
5. The photoreceptor mechanism: Genesis of electrical responses, photopic and scotopic Vision.
6. Visual pathways and effects of lesions of these pathways.
7. Color vision.
8. Other aspects of visual function – Monocular and binocular.
9. Eye Movements – Lateral and rotational.
10. Errors in visual process.

Hearing and Equilibrium

1. Introduction
2. Anatomic considerations of ear.
3. Hair cells.
4. Auditory pathway.
5. Mechanism of hearing.
6. Vestibular function.
7. Loss of hearing – Audiometry, test for conductive deafness, neural deafness and central deafness. Role of ear on equilibrium and posture- Role of reflexes.

Smell and Taste

1. Introduction
2. Smell
3. Receptors and pathways.
4. Physiology of olfaction and classification of olfaction.
5. Physiology of Taste – Taste bud, basic modalities of taste.
 - a. Receptor and pathways
 - b. Physiology of taste, taste adaptation and masking effect.



3.22 Core P11 – Special Senses Lab

Course Code: SH/PHY/501/C-11

Course ID: 52521

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

Course Learning Outcomes:

- The learner will increase their abilities in fixation and staining process of nervous tissue.
- They will develop their skill to measure visual acuity, colour blindness and tuning fork test for deafness.
- Student will be able to gather preliminary idea on audiometry through demonstration.

1. Principles of fixation and staining,
2. Staining and identification of fixed nervous tissue.
3. Determination of visual acuity by Snellen's chart / Landolt's C chart.
4. Determination of colour blindness by Ishihara chart.
5. Perimetry.
6. Determination of deafness by tuning fork test.
7. Silver nitrate preparation of corneal cell space.
8. Demonstration on hearing threshold by audio meter.



3.23 Core T12 – Endocrinology

Course Code: SH/PHY/502/C-12

Course ID: 52512

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25]

4 Credits

Course Learning Outcomes:

- From this core course students will develop their knowledge about elementary idea on endocrine glands.
- Learner will gather specific knowledge on chemical nature, mode of action of different hormones.
- The students will acquire knowledge about biological functions of different hormones.
- They will also get information regarding pathophysiology of endocrine glands.
- Students will also learn about bone physiology with regulation of blood calcium level.

Unit 1

General concept on Endocrinology

1. Introduction to endocrinology. Anatomy of endocrine system.
2. Hormones – Classification, hormone receptor- Fixed model and mobile model receptor. Genomic and non-genomic concept of regulation of hormone actions (c-AMP and tyrosine kinase). Positive and negative feedback mechanism.
3. Elementary idea of hormone action.
4. Hypothalamus: Basic concept of neurohormone. Hypothalamo-hypophyseal endocrine axis and portal system.

The Pituitary Gland

1. Introduction
2. Histology of pituitary gland.
3. Anterior pituitary and Posterior pituitary hormones.
4. Growth Hormone - Mechanism and function of GH and applied aspects.
5. Hyperfunction and hypofunction in humans.

Thyroid Gland

1. Introduction
2. Anatomic considerations.
3. Formation and secretion of thyroid hormones.
4. Transport of thyroid hormones.
5. Effects of thyroid hormones.
6. Regulation of thyroid secretion.
7. Primary and secondary hyper and hypo-thyroidism, LATS, Hashimoto thyroiditis, goiter, thyroid storm and Grave's disease.



Endocrine Functions of the Pancreas and the Regulation of Carbohydrate Metabolism

1. Introduction
2. Histology of pancreas.
3. Structure, biosynthesis, and secretion of insulin.
4. Function of insulin.
5. Mechanism of action.
6. Insulin excess.
7. Regulation of insulin secretion.
8. Glucagon - Biosynthesis and function.
9. Blood sugar homeostasis.
10. Other Islet cell hormones.
11. Hypoglycemia and diabetes mellitus in human.

The Adrenal Cortex and Medulla

- 1 Introduction
2. Adrenal morphology.
3. Adrenal Cortex- Structure, biosynthesis and functions of adrenocortical hormones.
4. Adrenal Medulla- Structure, biosynthesis and function of medullary hormones.
5. Regulation of adrenal medullary secretion.
6. Cushing syndrome, Addison's disease, Adaptive syndrome, Cuhn's disease and Pheochromocytoma.

Unit 2

Hormonal Control of Calcium Metabolism and the Physiology of Bone

1. Introduction
2. structure and histology of parathyroid gland.
3. Parathyroid hormones.
4. Calcium and phosphate metabolism.
5. Bone physiology.
6. Vitamin D and its biotransformation; role of vitamin D on calcium metabolism and bone health.
7. Vitamin D as a hormone.

Endocrine Functions of the Kidneys, Heart, and Pineal Gland

1. Introduction
2. The renin-angiotensin system.
3. Erythropoietin.
4. The Endocrine Function of the Heart: Atrial natriuretic peptide.
5. Pineal Gland-Neuroendocrine gland and function of melatonin.
6. Human Chronobiology, biological rhythms; basic concepts and implications.



3.24 Core P12 – Endocrinology Lab

Course Code: SH/PHY/502/C-12

Course ID: 52522

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

Course Learning Outcomes:

- Student will increase their ability to record the effect of oxytocin and adrenalin on uterine movement of rat.
- The learner will enhance their skill to determine obesity using anthropometric parameters.
- They will increase their skill on quantification of blood calcium level.
- Student will be able to identify specific pathophysiological disorders of endocrine system.

1. Study of the effects of oxytocin on uterine contraction of albino rats.
2. Study of the effects of adrenaline on intestinal and uterine movements of albino rats
3. Growth chart and interpretation.
4. Measurement of obesity by anthropometric parameters: Height, weight, BMI, chest circumference, MUAC and waist-hip ratio.
5. Quantification of serum calcium by colorimetric method using calcon indicator.
6. Case study on the basis of endocrine pathophysiology using photograph provided through lottery.

Suggested Readings:

1. Guyton, A.C. Hall, J.E. (2007) Text Book of Medical Physiology. Eleventh Edition. W.B. Saunders Co.
2. Kronenberg, H.M. Melmed, S. Polonsky, K.S. Larsen, P.R. (2009). Williams Textbook of Endocrinology. Eleventh Edition. Saunders.
3. Ganong, W.F. Review of Medical Physiology. Lange Medical Book. Prentice-Hall International.
4. Ghai, C.L. A Text Book of Practical Physiology. 8th Edition. Jaypee.
5. Hall J.E. (2016). Guyton & Hall Textbook of Medical Physiology. Second South Asia Edition.
6. Mahapatra, A.B.S. (2014). Essentials of Medical Physiology. Forth Edition. Current Books International.
7. Sembulingam, K. and Sembulingam, P. (2016). Essentials of Medical Physiology 7th Edition. Jaypee.
8. Khurana, I. (2015). Medical Physiology. 2nd Edition. Elsevier India.
9. Chatterjee, C.C. (2016). Human Physiology Volume 2. Eleventh Coloured Edition. CBS. Publishers and Distributors Pvt. Ltd.
10. Chaudhuri, S.K. (2008). Concise Medical Physiology. Sixth Edition. NCBA.
11. Mukherjee, K.L. (2004). Medical Laboratory Technology. Vol. I, Vol. II and Vol. III. Tata McGraw-Hill.
12. Hinkle, J.L. Kerry H. Cheever, K.H. (2013). Brunner & Suddarth's Handbook of Laboratory and Diagnostic Tests. 2nd Edition. LWW Publisher.
13. Godkar, P.B. Godkar. O.D. (2014). Textbook of Medical Laboratory Technology. 14th Edition.
14. Debnath, J. Byabharik Sharir Bignan. Shreedhar Prokashani, Kolkata.

**SEMESTER-VI****Core T13 – Reproduction**

Course Code: SH/PHY/601/C-13

Course ID: 62511

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25]

4 Credits

Course Learning Outcomes:

- The students will grow their knowledge on human reproduction and its associated abnormalities.
- Learner will also be enriched with knowledge about population control and family planning.
- They will learn about the basic concept of menstruation and its hormonal control along with abnormalities.
- From this course our learners will learn about the physiology of pregnancy, parturition and lactation.

1. Introduction on reproductive system.
2. Sex differentiation and development:
 - a. Chromosomal sex.
 - b. Embryology of the human reproductive system.
 - c. Aberrant sexual differentiation.
 - d. Puberty and its hormonal control.
 - e. Precocious and delayed puberty.
 - f. Menopause.
3. Pituitary Gonadotropins and Prolactin.
4. The male reproductive System:
 - a. Primary and secondary sex organs and their functions.
 - b. Structure of sperm, motility, capacitation and viability of sperm.
 - b. Gametogenesis, spermiation and ejaculation.
 - c. Endocrine function of the testes.
 - d. Control of testicular function.
 - e. Abnormalities of testicular function.
5. The female reproductive system
 - a. Primary and secondary sex organs and their functions.
 - b. Oogenesis and ovulation.
 - c. Menstrual cycle and its hormonal control.
 - d. Endocrine function of ovary.
 - e. Control of ovarian function.
 - f. Abnormalities of ovarian function.
6. Fertilization
7. Implantation
8. Male and female infertility.
9. Placenta – Structure, hormones and function.
10. Pregnancy – Physiology of pregnancy, hormonal regulation and pregnancy test.
11. Parturition.
12. Development of mammary gland, lactation and regulation of milk secretion.
13. Population Control- Family planning and contraceptive measurement.



3.26 Core P13 – Reproduction Lab

Course Code: SH/PHY/601/C-13

Course ID: 62521

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

Course Learning Outcomes:

- The student will develop their skill to study of estrous cycle.
- Learner will increase their ability on staining and identification of testicular and ovarian tissue.
- They will be able to perform pregnancy test by immunological method.
- Student will also improve their knowledge about reproductive health by performing semen analysis.

1. Study of estrous cycle.
2. HE staining and identification of testis, ovary and uterus of paraffin embedded tissue section.
3. Pregnancy test from human urine sample by immunological method.
4. Semen analysis: Sperm count, sperm motility and sperm viability by eosin and nigrosine staining.



3.27 Core T14 – Excretion, Skin and Body Temperature Regulation

Course Code: SH/PHY/602/C-14

Course ID: 62512

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25]

4 Credits

Course Learning Outcomes:

- From this course the learner will study on excretory system with special emphasis on electrolytes and water balance of the human body.
- They will also get information about non-excretory function of kidney.
- Student will be enriched with the knowledge about structure and function of skin with physiology of sweating.
- This course will help to gather knowledge about regulation body temperature and its associated abnormalities.

Excretion

1. Introduction of renal system and its structure.
2. Function of malpighian corpuscles and renal tubule.
3. Urine formation – Glomerular ultrafiltration, tubular reabsorption and tubular secretion.
4. Physical properties and composition of urine (normal and abnormal).
5. Role of renal buffers on acid base regulation of urine.
6. Regulation of Na⁺ and H₂O balance by renal system.
7. Counter current system.
8. Renal circulation and its peculiarities.
9. Diuretics and diuresis.
10. Disorders of renal functions- renal failure (Dialysis), renal stone, glomerulonephritis, nephrotic syndrome.
11. Urinary bladder: Structure, filling and emptying of urinary bladder (micturition)
12. Renal function test: Inulin and urea clearance test, renal threshold values.
13. Non-excretory function of kidney, structure and function of JG apparatus.

Skin

1. Structure of skin and its functions.
2. Sweat Glands - Types, structure and composition of sweat, mechanism of sweat formation, secretion and its regulation.
3. Sebaceous glands - Structure and functions.
4. Insensible perspiration in brief.

Body Temperature

1. Physical and physiological processes of thermoregulation, routes of thermogenesis and thermolysis, concept of thermokinetics, homeotherm, poikilotherm, hibernation and aestivation.
2. Regulation of body temperature in homeotherms – Role of endocrine and nervous system.
3. Pyrexia, hyperthermia and hypothermia.



3.28 Core P14 - Excretion, Skin and Body Temperature Regulation Lab

Course Code: SH/PHY/602/C-14

Course ID: 62522

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

Course Learning Outcomes:

- The learner will get their ability to perform routine examination of urine to identify abnormal constitutions.
- Student will grow their skill to perform microscopic examination of urine also to identify RBC, pus cell, cast etc.
- They will enhance their ability to identify the relation between exercise, heart rate and body temperature.

1. Testing of normal constituents of urine (Biochemical Test)
2. Identification of abnormal constituent of urine (Biochemical Test)
3. Microscopic observation of RBC, pus cell and cast in urine.
4. Measurement of body temperature and heart rate in graded exercise.

Suggested Readings

1. Chatterjee, C.C. (2016). Human Physiology Volume 2. Eleventh Coloured Edition. CBS. Publishers and Distributors Pvt. Ltd.
2. Mahapatra, A.B.S. (2014). Essentials of Medical Physiology. Fourth Edition. Current Books International.
3. Sembulingam, K. and Sembulingam, P. (2016). Essentials of Medical Physiology 7th Edition. Jaypee.
4. Khurana, I. (2015). Medical Physiology. 2nd Edition. Elsevier India.
5. Guyton, A.C. Hall, J.E. (2007) Text Book of Medical Physiology. Eleventh Edition. W.B. Saunders Co.
6. Ganong, W.F. Review of Medical Physiology. Lange Medical Book. Prentice-Hall International.
7. Chaudhuri, S.K.(2008). Concise Medical Physiology. Sixth Edition. NCBA.
8. Pal, G.K. Pal, P. (2013).Textbook of Practical Physiology. Third Edition. Universities.
9. Note Books on Practical Biochemistry. Published by The Physiological Society of India. Kolkata.
10. Mukherjee, K.L. (2004). Medical Laboratory Technology. Vol. I, Vol. II and Vol. III. Tata McGraw-Hill.
11. Hinkle, J.L. Kerry H. Cheever, K.H. (2013). Brunner & Suddarth's Handbook of Laboratory and Diagnostic Tests. 2nd Edition. LWW Publisher.
12. Godkar, P.B. Godkar. O.D.(2014). Textbook of Medical Laboratory Technology. 14th Edition.
13. Debnath J. Byabharik Sharir Bignan. Shreedhar Prokashani, Kolkata.



4. Discipline Specific Elective Courses

**SEMESTER-V****4.1 DSE T1 – Biostatistics and Computer Application****Course Code: SH/PHY/503/DSE-1****Course ID: 52516****[Theory: Credits 4 (4 Lectures/Week)/ Marks 25]****4 Credits*****Course Learning Outcomes:***

- The course will enable the students to develop their knowledge about principle and application of statistics in biology.
- This core course will fortify the students to learn about statistical sampling, frequency distribution and graphical representation of data.
- The course will strengthen the students with in-depth on statistical analysis of dispersion.
- This core course will provide the students better understanding on Student's t-distribution, probability and hypothesis of biostatistics.

Concepts in Biostatistics

1. Scope of statistics – Principles of statistical analysis of biological data.
2. Basic concepts – Variable, parameter, statistics and sampling.
3. Classification of statistics (Brief idea of statistics of location, statistics of dispersion, statistics of co-relation and statistics of regression). Brief idea of parametric and non-parametric statistics.
4. Presentation of data - Frequency distribution, frequency polygon, histogram, bar diagram and pie diagram.
5. Measurement of central tendency- Mean, median, mode in grouped and ungrouped data.
6. Computation of dispersion- Mean deviation, standard deviation, standard error of mean and variance.
7. Standard score.
8. Probability- General concept.
9. Normal distribution - Properties and assumption, skewness and kurtosis.
10. Student's t-distribution- Properties and assumption.
11. Testing of hypothesis - Null hypothesis, alternative hypothesis, errors of inference (Type-I and type-II), degrees of freedom, levels of significance, students' t-test (Single group paired observation study, individual matched grouped study) and z-score for significance of difference.
12. Non-Parametric - Chi-square test (Assumption and test for independence).



Concepts in Computer Application

1. History of computer, basic components of computer and their importance.
2. Binary number, decimal number, addition, subtraction, multiplication and division using binary number.
3. Basic concept of software and computer language.
4. Concept of MS word, Excel and Power point.
5. Concept of networking and website.
6. Application of computer in Physiology.



4.2 DSE P1 – Biostatistics and Computer Application Lab

Course Code: SH/PHY/503/DSE-1

Course ID: 52526

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

Course Learning Outcomes:

- This practical course will enable students to calculate statistical data, collected from field study.
- This practical course will fortify the students to develop their skill for preparing project report.

Field Study Report

A report (hand-written) on the basis of field survey from one of the followings topics by using basic statistical tools -

1. Physiological parameters (at least three parameters to be measured): Heart rate, blood pressure, respiratory rate, PFI, blood hemoglobin content, differential count of WBC and visual acuity.
2. Anthropometric Measurements (at least three parameters).
3. Epidemiological studies - Cross sectional and vertical.



OR
4.1 DSE T1 – Human Nutrition and Dietetics

Course Code: SH/PHY/503/DSE-1

Course ID: 52516

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25]

4 Credits

Course Learning Outcomes:

- This core course will enrich our students to develop their knowledge about health and nutrition of community.
- This course will fortify our students to learn about dietary requirements, calory requirements and biological value of nutrients.
- This course will enable our students to grow up their knowledge about the basic principle of diet chart preparation for growing child, adult man and woman, pregnant and lactating mother.
- They will get knowledge about physiological importance of vitamin and minerals.

1. Introduction- Basic concept of nutrition and dietetics, concept of undernutrition and overnutrition (Obesity).
2. Constituents of food - Macro and micro-nutrients and their significance.
3. Basal metabolic rate -Factors, determination by Benedict-Roth apparatus and significance.
4. Respiratory quotient and its significance.
5. Specific dynamic action- Definition, normal values of different food stuffs and its importance.
6. Calorific value of macronutrients.
7. Body calorie requirements – In different types of work and adult consumption unit.
9. Dietary requirements of carbohydrate, protein, lipid and other nutrients at different phases of human life cycle RDA as per ICMR.
10. Balanced diet and principles of formulation of balanced diets for growing child, adult man and woman, pregnant woman and lactating woman.
11. Nitrogen balance, essential amino acids, biological value of proteins, NPU, DC and PER.
12. Supplementary value of protein.
13. Dietary fibres – Source, types, composition and importance.
14. Resistance starch and its importance.
15. Vitamins and Minerals (Fe, Na, K, Ca, P, I, Zn and selenium) – Sources, daily requirement, physiological role and deficiency symptoms.
16. Nutraceutical - Concepts and their importance.
17. Principle of diet survey.
18. Composition and nutritional value of common food stuffs.
19. Physiology of starvation and obesity.
20. Space nutrition in brief.



4.2 DSE P1 – Human Nutrition and Dietetics Lab

Course Code: SH/PHY/503/DSE-1

Course ID: 52526

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

Course Learning Outcomes:

- This practical course will develop students' ability to collect nutritional data for the preparation of diet survey report.
- This practical course will fortify the students to develop their skill for preparing field survey report.

Diet Survey /Field Study Record

Any one report (hand-written) on the basis of diet survey or field survey from the following topics-

1. Diet survey report (hand-written) of a family (as per ICMR specification): Each student has to submit a report on his/her locality/ costal area/ hilly area/ coal mines area.
2. A report (hand-written) on the basis of field survey from One of the followings:
 - a. Physiological parameters of human (at least three parameters).
 - b. Anthropometric measurements on human (at least three parameters).
 - c. Epidemiological studies on complete and partial immunization programme / Vitamin A prophylaxis programme / Nutrition status assessment of pre school children.



4.3 DSE T2 – Microbiology and Immunology

Course Code: SH/PHY/504/DSE-2

Course ID: 52517

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25]

4 Credits

Course Learning Outcomes:

- From this core course student will develop their knowledge about microbes and its growth along with different types of classification.
- This course will fortify our students to develop their knowledge about bacterial metabolism, conjugation, transformation and transduction.
- They will get elementary idea of bacteriostatic, bactericidal agents and antibiotics.
- This course will provide knowledge about COVID-19.
- Students will improve their knowledge about cell mediated and humoral immunity.
- Learner will get information on universal protocol of immunization against communicable diseases.

Microbes

1. Brief introduction about microbes, structure and morphological classification of different microbes and bacterial spore.
2. Bacterial nutrition, bacterial culture media and bacterial growth curve.
3. Bacterial genetics – Conjugation, transformation and transduction.
4. Bacterial metabolism – Fermentation (Ethanol and lactic acid) and Entner-Doudoroff pathway and their importance.
5. Elementary idea of bacteriostatic, bactericidal agents and antibiotics.
6. Gram positive, Gram negative, pathogenic and nonpathogenic bacteria. Sterilization and pasteurization.
7. Brief idea on acid fast bacteria.
8. Viruses - Structure and types, lytic and lysogenic cycles, effect of RNA virus on human body system. Prions – Basic ideas and prion diseases.
9. Basic concept of COVID-19.

Overview of Immune System

1. Introduction about immune system and immune organs (primary and secondary).
2. Classification of immunity- Innate and acquired immunity, humoral and cell mediated immunity, natural and artificial immunity and herd immunity.
3. Immuno-competent Cells- B lymphocytes and T lymphocytes (T_H , T_S , T_{NK} , T_C & T_{DTH}), APC.
4. Major Histocompatibility Complex (MHC)-Type - I&II and interferon.
5. Immunoglobulin - Classification, basic structure and function.
6. Antigen-antibody interaction - Different types (Precipitation, coagulation, agglutination, neutralization and flocculation).



7. Cytokines, lymphokines, inflammation and hypersensitivity and its types.
8. Activation of complement system - Pathways (brief concept of classical and alternative pathway). Brief idea on MAC complex.
9. Vaccination – Principles, Universal protocol on Immunization-brief idea, primary and secondary reaction of vaccination, health reaction due to vaccination, memory cell formation due to vaccination and importance of immunization and concept on booster dose.
10. Basic principles of immunological techniques and their application - RIA and ELISA.
11. Immunopathology - Basic principles of autoimmune disease (Hashimoto disease, SLE, Myasthenia gravis and Graves' disease).
12. AIDS- Causative virus, mode of transmission, effects on human body, preventive measures.



4.4 DSE P2 – Microbiology and Immunology Lab

Course Code: SH/PHY/504/DSE-2

Course ID: 52527

Course Learning Outcomes:

- This practical course will enable our students to develop their knowledge on staining and identification of Gram positive and Gram-negative bacteria.
- The core course will fortify the students to develop their skill for preparing bacterial culture media.
- Learner will gain their knowledge on blood group detection and Rh typing.
- They acquire their ideas on radial immuno-diffusion and Acid-fast staining of bacteria through demonstration process.

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15]

2 Credits

1. Gram staining of bacteria and identification of Gram positive and Gram-negative bacteria.
2. Blood grouping and Rh typing.
3. Bacterial spore staining.
4. Preparation of bacteria culture media.
5. Demonstration: Radial immuno-diffusion and Acid-fast staining of bacteria.



OR
4.3 DSE T2 – Genetics and Molecular Biology

Course Code: SH/PHY/504/DSE-2

Course ID: 52517

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25]

4 Credits

Course Learning Outcomes:

- From this course students will develop their knowledge on Mendelian genetics.
- Learners will enrich their ideas about bacterial genetics.
- This course will strengthen our students with in-depth on crossing over, linkage, gene mapping and SNP analysis.
- This core course will provide the learner better idea on basic concept of molecular biology.

Genetics

1. Basic principles of Mendelian genetics - Monohybrid and dihybrid.
2. Test and back crosses.
3. Bacterial genetics - Transformation, transduction, conjugation (mention of F⁺ /F⁻, Hfr strain, function of pilus).
4. Extension of Mendelism - Epistasis and its different types present in animals. Penetrance, expressivity, pleiotropism. Numerical and structural variations in chromosome - Basic concepts of aneuploids and polyploids.
5. Crossing over and Linkage.
6. Gene Mapping and SNP analysis.
7. Human Cytogenetics - Human karyotype, banding technique, use of human cytogenetics in medical science, inborn errors of metabolism, aneuploidy in humans. Sex determination and sex linkage.

Molecular Biology

1. Basic concept of molecular biology.
2. DNA replication - Meselson and Stahl Experiment, DNA polymerases, ligases and other regulatory proteins.
3. Genetic Code - Properties and Wobble hypothesis.
4. Transcription - RNA polymerase and other regulatory mechanism in prokaryotes.
5. Translation – Codon-anticodon interaction and mechanism in prokaryotes.
6. Regulation of gene expression: Operon Concept – Lac Operon in brief.
7. Gene mutation – Agents and types.
8. DNA repairing processes.
9. Concept of oncogenes and properties of cancer cells.
10. Recombinant DNA technology in brief and its applications – Gene therapy, transgenic animal.
11. Polymerase chain reaction (PCR) and RTPCR.



4.4 DSE P2 – Genetics and Molecular Biology Lab

Course Code: SH/PHY/504/DSE-2

Course ID: 52527

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

Course Learning Outcomes:

- This practical course will provide wide range of knowledge about retrieval of amino acid sequence from mRNA.
- Students will gain their knowledge on retrieval of codogen in DNA from codon sequence of mRNA.
- The discipline specific elective course will fortify the students to develop their skill about extraction of DNA and RNA from supplied sample.
- Learner will gain their skill about quantification of protein.

1. Retrieval of amino acid sequence from mRNA.
2. Retrieval of codogen in DNA from codon sequence of mRNA.
3. Extraction of DNA from supplied sample, extraction of RNA from supplied sample.
4. Quantification of Protein by Bradford Reagent
5. Demonstration-DNA gel electrophoresis (Agarose Gel).



SEMESTER–VI

4.5 DSE T3 – Ergonomics and Occupational Physiology

Course Code: SH/PHY/603/DSE-3

Course ID: 62516

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25]

4 Credits

Course Learning Outcomes:

- From this core course students will develop their knowledge about physiological work load, concept of work rest cycle and its significance
- Student will learn about relation-ship of man-machine-environment in work places for safety and wellbeing.
- Student will gather the knowledge how to reduce the occupational health hazards and on industrial safety devices.

1. Genesis and concept of ergonomics – Man-machine-environment interaction.
2. Importance of ergonomics in occupational health and well-being.
3. Classification of Physiological work load. Concept of work rest cycle and its significance.
4. Physical work environment: (a) Thermal environment, its' effect, Heat stress indices, (b) Noise and vibration, its' effect on workers. Occupational deafness, (c) Illumination level and its' effect on visual performances, (d) Ergonomic principles of control of Physical hazards.
5. Static anthropometry, application of anthropometric data in design. Somatotyping.
6. User interface and control display compatibility.
7. Prevention of accident and concept of industrial safety.
8. Occupational diseases: Pneumoconiosis, asbestosis, silicosis and work-related musculoskeletal disorders.



4.6 DSE P3 – Ergonomics and Occupational Physiology Lab

Course Code: SH/PHY/603/DSE-3

Course ID: 62526

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

Course Learning Outcomes:

- Students will develop their skill to measure about working heart rate by ten beats methods.
- Learners will increase their ability to explain the relationship between blood pressure and graded exercise with their practical knowledge.
- They will also get their skill to measure different anthropometric parameters along with calculation of BSA and BMI.
- From this core course learners will develop their ability to measure relative humidity and noise level at work place.

1. Measurement of working heart rate by ten beats methods.
2. Measurement of blood pressure before and after different grades of exercise.
3. Measurement of some common anthropometric parameters (Sitting and standing posture).
4. Calculation of BSA and BMI from anthropometric data.
5. Measurement of WBGT indices.
6. Measurement of noise level by noise level meter.
7. Demonstration of determination of cardiac cost of specific work.

**OR****4.5 DSE T3 – Environmental Physiology and Toxicology****Course Code: SH/PHY/603/DSE-3****Course ID: 62516****[Theory: Credits 4 (4 Lectures/Week)/ Marks 25]****4 Credits*****Course Learning Outcomes:***

- From this discipline specific course students will develop their knowledge on environmental pollution and its health hazards.
- They will develop their ideas on radioactive pollution and concept of hygiene, sanitization and their impact on public health.
- Learner will grow their knowledge on air, water and food borne diseases and also food additive and food adulteration along with vector borne epidemic diseases.
- Student will gain their knowledge on environmental management, environmental ethics, conservation and different Acts and its importance.

Unit 1**Environmental Pollutions and Health Hazards**

1. Air Pollution: Definition, sources, air pollutants, effects of air pollution on human health, control of air pollution, concept of ozone hole, green house effects and global warming, acid rain, photochemical smog.
2. Water Pollution: Definition, types, water pollutants, health hazards, controlling measures, biological oxygen demand (BOD), thermal pollution, arsenic pollution, concept of safe drinking water standards.
3. Soil Pollution: Causes, health hazards and management, soil Ph and soil moisture level study, solid waste managements – Bioremediation and phytoremediation.
4. Sound Pollution: Definition, concept of noise, source of sound pollution, effects of sound pollution on human health, management of sound pollution and noise index (Noise standards).
5. Radionuclide Pollution: Ionizing radiations, effects of ionizing radiation on human health, permissible doses.
6. Concept of hygiene and sanitization and their impact on public health.
7. Air, Water, Food Borne Diseases – Influenza, cholera, typhoid and hepatitis A, their causes, symptoms and control.
8. Food additives and adulterants: Definition, examples and human health hazards.
9. Vector Borne Epidemic Diseases: Malaria and Plague-etiology and control.



Environmental management

1. Environmental ethics.
2. Conservation of topsoil, ground water and wild lives; rain water harvesting; sanctuary, national park, biosphere reserve, wildlife (conservation) Act, 1992 and EPA Act and importance.

Unit 2

Toxicology

1. General concept on Toxicology.
2. Factors affecting toxicity.
3. Dose response curve, LD₅₀, LOD₅₀, ED₅₀, TD₅₀, NOEL, LOEL and therapeutic index.
4. Concept of acute and chronic effects of toxins.
5. Birth defects and teratogens in brief.
6. Concepts of biomagnification and bioconcentration.
7. Brief idea on Prevention of Food Adulteration Act, 1954.
8. Other Food Toxicants: BPA, BPS, pesticides, PAH, Dioxin, PCB, heavy metals: Pb, Hg, Cd, As etc.



4.6 DSE P3 – Environmental Physiology and Toxicology Lab

Course Code: SH/PHY/603/DSE-3

Course ID: 62526

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

Course Learning Outcomes:

- This course will help our students to enhance their skill to measure dissolved oxygen in water sample.
- They will be able to measure relative humidity and suspended particulate matter in air.
- Lerner will also get their skill to measure noise and light intensity of different working places.
- From this discipline specific elective course student will also develop their ability to soil pH in different climatic areas.

1. Measurement of dissolved oxygen by Winkler's method.
2. Relative humidity measurement by dry bulb and wet bulb thermometer.
3. Suspended particulate matter of specific air sample.
4. LD₅₀ measurement from provided graph.
5. Noise intensity measurement by sound level meter.
6. Light intensity measurement by Lux meter.
7. pH measurement of soil and water in different climatic areas.



4.7 DSE T4 – Sports and Exercise Physiology

Course Code: SH/PHY/604/DSE-4

Course ID: 62517

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25]

4 Credits

Course Learning Outcomes:

- From this course students will develop their knowledge on Sports and Exercise Physiology.
- This course will fortify our student to develop their knowledge on Physiological work and endurance activity.
- Learner will learn about role of exercise and training on health and wellbeing.
- Student will gather their knowledge about cardio-respiratory responses during different grades of exercise.
- This course will also provide basic concept of bioenergetics with different sources of energy during exercise.

1. Introduction on exercise and sports.
2. Physiological work - Isotonic, isometric, isokinetic, positive and negative. Brief idea on muscular power, strength and endurance.
3. Importance of regular exercise in health and wellbeing.
4. Basic concept of bioenergetics, energy sources during exercise (Phosphagen, anaerobic system and aerobic system).
5. Muscles: Types and fiber classification and their role in sports.
6. Cardio-respiratory responses during different grades of exercise.
7. Concept of excess post-exercise oxygen consumption (EPOC), physiological fatigue and recovery.
8. Anaerobic and aerobic work. Aerobic work capacity - Measurement, physiological factors and applications.
9. Training: Principles of physical training, training to improve aerobic and anaerobic power. Effects of overtraining and detraining.
10. Pre-game, intra-game and post-game meals and their nature and importance.
11. Nutritional supplements in exercise and sports, ergogenic aids – Brief concept. Sports drink. Glycogen loading on sports performances.
12. Sports injury and its management.
13. Basic idea on sports rehabilitation and sports medicine.



4.8 DSE P4 – Sports and Exercise Physiology Lab

Course Code: SH/PHY/604/DSE-4

Course ID: 62527

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

Course Learning Outcomes:

- From this course students will develop their skill on measurement and interpretation of blood pressure.
- Student will increase their ability to determine Physical Fitness Index and to record recovery pulse rate after dynamic and static exercise.
- They will also be able to calculate endurance time by hand grip dynamometer.
- Learner will develop their knowledge to determine VO₂ max by Queen College Step Test.

1. Measurement of blood pressure before and after different grades of exercise.
2. Recording of recovery heart-rate after standard exercise.
3. Determination of Physical Fitness Index by Harvard Step Test (Modified).
4. Measurement of body fat percentage.
5. Determination of endurance time by hand grip dynamometer.
6. Determination of VO₂ max by Queen College Step Test.
7. Six-minute walk test.



OR

4.7 DSE T4 – Nanobiotechnology and Bioinformatics**Course Code: SH/PHY/604/DSE-4****Course ID: 62517****[Theory: Credits 6 (6 Lectures/Week)/ Marks 40]****6 Credits*****Course Learning Outcomes:***

- This course will provide specific idea about nanoscience and nano-biotechnology.
- This course will fortify our student to develop their knowledge on characterization of nanomaterials.
- They will get information about application of nanomaterials in modern science and cancer therapy.
- Student will gather their knowledge about loading and unloading of desired substances to and from the nano-particle.
- This course will also provide basic concept of bioinformatics with different major bioinformatic resources.

1. Introduction to nanoscience and nano-biotechnology.
2. Definition of a nano-particles, features and their application on human health maintenance.
3. Types of Nanostructures; Types of nanocrystals - One dimensional (1D)-Two dimensional (2D) -Three dimensional (3D) nanostructured materials - Quantum dots - Quantum wire; Core/Shell structures, micelle and nano-capsule.
4. Synthesis of nanomaterials in brief.
5. Loading and unloading of desired substances to and from the nano-particle, factors affecting and its measurement.
6. Characterization techniques for Nanomaterials: X-ray diffraction; Scanning Electron Microscope (SEM); Transmission Electron Microscopy (TEM).
7. Properties of Nanomaterials: Size dependent properties - Mechanical, Physical and Chemical properties. Types of Nanomaterials: Carbon Nanotubes (CNT) - Metals (Au, Ag) - Metal oxides (TiO₂, CeO₂, ZnO) – Semiconductors (Si, Ge, CdS, ZnSe) - Ceramics and Composites. Applications of Nanomaterials in Biology: Biochemical sensors; Imaging; Cancer treatment etc.
8. Toxicity of nanomaterials in the environment – Health threats.
9. Brief ideas on Bioinformatics - Computational technology and bioinformatics, along with their scope.
10. Major Bioinformatic resources-NCBI, EBI, ExPaSy.
11. Basic Local Alignment Search Tolls (BLAST), Other Blast Options, PSI-BLAST. Application of BLAST tool.
12. Multiple sequence alignment and its applications.



Suggested Readings

1. Pelczar, M.J. (2001) Microbiology. 5th edition, Tata McGraw-Hill Co, New Delhi.
2. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
3. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology. Pearson Benjamin Cummings, USA. 8th edition.
4. Saha, I. Paul. B. (2016). Essential of Biostatistics. 2nd Edition. Academic Publishers.
5. Giri, P.K. Banerjee, J. Statistical Stools and Techniques. Academic Publishers.
6. Das, D. Handbook of Practical Microbiology, Cell Biology Genetics and Biometry. Academic Publishers.
7. Srilakshmi, B. (2016). Nutrition Science. Fifth Edition. New Age International Publishers.
8. Srilakshmi, B. (2014). Dietetics. Seventh Edition. New Age International Publishers.
9. Das S. Textbook of Normal and Therapeutic Nutrition. Academic Publishers.
10. Das S. (2016).Textbook of Community Nutrition. 2nd Edition. Academic Publishers.
11. Basu, P. Nutritional Biochemistry. Academic Publishers.
12. Srilakshmi, B. (2015). Food Science. Sixth Edition. Age International Publishers.
13. Swaminathan, M. (2012). Handbook of Food and Nutrition. Jain Book Agency.
14. Swaminathan, M. (2012). Essentials of Food and Nutrition. Vol. I AND Vol. II. Jain Book Agency.
15. Saha, T.K. (2013). Ecology and Environmental Biology. Books & Allied Ltd.
16. Banerjee, P.K. (2007). Introduction to Biostatistics.
17. Das, D. Das A. (2013). Statistics In Biology And Psychology. Sixth Edition. Academic Publishers.
18. Chad L. Cross Wayne W. Daniel. (2014). Biostatistics: Basic Concepts and Methodology for the Health Sciences. Wiley.
19. Rao, S. (2012). Introduction to Biostatistics and Research Methods. Fifth Edition. PHI.
20. Bhadra, K.A. (2012). Mahajan'S Methods In Biostatistics For Medical Students And Research Workers. Eight Edition.
21. Reddy N. (2015).The Essentials of Forensic Medicine And Toxicology. 33rd Edition.
22. Tripathi, K.D. (2013). Essential of Medical Pharmacology. Seventh Edition. Jaypee.
23. Verma, P.S. and Agarwal, V.K. (2004). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Pvt. Ltd.
24. David Freifelder. (2008). Molecular Biology. 2nd Edition. Narosa Publishing House.
25. Goodman & Gillman's The Pharmacological Basis Of Therapeutics With DVD (Goodman and Gilman"S the Pharmacological Basis of Therapeutics. 12th Edition. (2011).
26. Berk, A. Kaiser, C.A. Lodish, H, Amon, A. (2016). Molecular Cell Biology WH Freeman.
27. Wilson, K. and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. Seventh Edition.
28. Gardner, E.J. Simmons, M.J, Snustad, D.P. (2006) Principles of Genetics. Eighth Edition. Wiley.
29. Ozsoz, M.S. (2012). Electrochemical DNA Biosensors. Pan Stanford Publishing Pte Ltd.



30. Sethi, T. (2012). Miracles Of Nano-tech With Bio-tech: Magic Of Nano-technology With Combination Of Bio-technology Related To Human Beings. Lap Lambert Academic Publishing.
31. Guo, P, Haque., F. (2015). RNA Nanotechnology and Therapeutics (Methods in Molecular Biology). CRC Press Taylor and Francis.
32. Dutta, P.K. Dutta J. (2016). Multifaceted Development and Application of Biopolymers for Biology, Biomedicine and Nanotechnology (Advances in Polymer Science). Springer.
33. Ghosh, J. Mallick B. Bioinformatics: Principles and Applications. Springer.
34. Rastogi S.C. Mendiratta, N. Rastogi, P. (2013). Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery. Fourth Edition.
35. Mount , David W. (2005). Bioinformatics: Sequence and Genome Analysis
36. Francis Ouellette, B.F. Baxevanis, A.D. (2009). Bioinformatics. 3rd Edition. Wiley.
37. Ananthanarayan, R. Kapil, A. A & P Textbook of Microbiology. 9th Edition.
38. Wilson, D.W. William's Text Book of Endocrinology. Saunders of Co.
39. DeGroot. L.O. Endocrinology. Vols. I, II and III W.B. Saunders Co.
40. Knobil E. and Nail, D.J. The Physiology of Reproduction, Vols I, & II. Raven Press.
41. William D. McArdle, Frank I. Katch, Victor L. Katch. Essentials of Exercise Physiology. 5th International edition. Lippincott Williams and Wilkins.
42. Astrand, P.O. Rodhal. K. Dahl, H.A. (2003). Forth Edition. Mc Graw-Hill Book Co.
43. Shaver, L.G. Essentials of Exercise Physiology. Surjeet Publications.
44. McCormick, E.O. and Sanders, M. Human Factors in Engineering and Design by Tata Mc Graw Hill.
45. Fox, E.L. (1985). Sports Physiology. Saunders College Publishing Holt-Saunders
46. Fox, E.L. Mathews, D.K. The Physiological Basis of Physical Education and Athletics by and. Saunders College Publishing.
47. Durin, J.V.G.A. and Passmore, R. Energy, Work and Leisure. Heinemann Educational Books.
48. Simmons, S. (2006). Principles of Genetics. Fourth Edition. Wiley Asia Student Edition.
49. Dhara, P. (2006). Computer in Biological Science Book. Academic Publishers.
50. Salaria, R.S. (2017). Computer Fundamentals. Khanna Book Publishing.
51. Claverie, J.M. (2003). Bioinformatics for Dummies. 2nd Edition, Wiley.
52. Durbin, R. Eddy, S. Krogh, A. Mithchison, G. (2007). Biological sequence Analysis . Cambridge University Press.



5. Skill Enhancement Courses



SEMESTER-III

5.1 SEC P1 – Detection of Food Adulteration Lab

Course Code: SH/PHY/305/SEC-1

Course ID: 32525

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 40] 2 Credits

Course Learning Outcomes:

- This skill enhancement course will help to detect different adulterants in food stuff.
- They acquire their skill for qualitative identification of metanil yellow, rhodamin B, saccharin, monosodium glutamate, aluminium foil, chicory, bisphenol A and bisphenol S in food stuff.
- Learner will gather their skill about detection of heavy metals in different food.

Qualitative tests for Food Adulteration

Qualitative tests for identifying food adulterants in some food samples:

Metanil yellow, rhodamin B, saccharin, monosodium glutamate, aluminium foil, chicory, bisphenol A and bisphenol S, chocolate brown HT, margarine, Pb, Hg, As, PCB, Dioxin etc. in turmeric powder, besan, laddoo, noodles, chocolate and amriti.

**OR****5.1 SEC P1 – Hematological Techniques Lab****Course Code: SH/PHY/305/SEC-1****Course ID: 32525****[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 40]****2 Credits*****Course Learning Outcomes:***

- This skill enhancement course learner will gain their knowledge about preparation of blood smear, staining along with identification of blood cells.
- From this paper students will increase their knowledge and techniques about total count of RBC and WBC.
- They acquire their skill for measurement of hemoglobin percentage and determination of haematocrit, MCV, MCH, MCHC, bleeding time and clotting time.
- Learner will fortify their skill on estimation of urea and creatinine in serum sample along with estimation of blood sugar level.

1. Preparation of blood smear and identification of blood cells.
2. ESR measurement by Wintrobe's or Western green method.
3. Total count of RBC and WBC.
4. Determination of haematocrit, MCV, MCH, MCHC, bleeding time and clotting time.
5. Measurement of hemoglobin (Cyanmethemoglobin method) in blood.
6. Preparation of serum.
7. Estimation of serum urea and creatinine by using kit.
8. Blood sugar estimation By Nelson-Somogyi method.
9. Osmotic fragility test.
10. Quantification of serum total protein by Biuret method.



SEMESTER-IV

5.2 SEC T1 – Clinical Biochemistry

Course Code: SH/PHY/405/SEC-2

Course ID: 42515

Theory: Credits 2 (2 Lectures/Week)/ Marks 40]

2 Credits

Course Learning Outcomes:

- Student will be developing their hands of knowledge on principle and application of colorimeter and spectrophotometer.
- Learner will gain their ideas on pathophysiological significance of blood parameters.
- From this course learners will acquire their knowledge on pathological significance of some enzymes and proteins.

- 1.Principle and application of colorimeter and spectrophotometer.
- 2.Pathophysiological significance of blood parameters – Glucose, serum protein, albumin, urea, creatinine, uric acid, bilirubin and ketone bodies.
- 3.Alteration of lipid and thyroid profile in health and disease.
- 4.Strength of solution: Normality and molarity with calculation.
- 5.Pathological significance of some enzymes and proteins: Lactate dehydrogenase, glucose-6-phosphate dehydrogenase, creatin kinase, amylase, ACP, ALP, Beta-glucuronidase, ALT, AST, Lipase, Gamma-glutamyl transpeptidase, cardiac troponins and CRP.

**OR****5.2 SEC T1 – Clinical Microbiology and Bio-Medical Technology****Course Code: SH/PHY/405/SEC-2****Course ID: 42515****Theory: Credits 2 (4 Lectures/Week)/ Marks 40]****2 Credits*****Course Learning Outcomes:***

- Lerner will develop their knowledge on clinical microbiology along with biomedical instrumentation and different modern techniques.
- They will also learn about how to handle sample of infectious disease and their precautionary measures.
- From this course student will fortify their knowledge on bacterial growth curve, generation time along with different type of culture media.
- Student will develop their ideas about principle and application of modern biomedical instrumentation.

1. Introduction on Clinical Microbiology and Bio-Medical Technology.
2. Classification of bacteria. Cell wall structure of Gram-positive and Gram-negative bacteria.
3. Basic precautionary measures taken against bacterial and viral infection –
 - a. During sample collection.
 - b. At the time of handling in the laboratory.
4. Identification of tubercular bacteria in sputum (Demonstration: with utmost precautionary measures).
5. Bacterial growth curve and generation time.
6. Different types of culture and media.
7. Different types of vectors – Plasmid, Cosmid.
8. Biomedical techniques – ECG, EEG, EMG, ERG, PCR, RT-PCR (Principle, procedure, normal wave and clinical application).
9. Principle and application of – CO₂ incubator, Doctor's Centrifuge, Colorimeter, Spectrophotometer and Laminar air flow.

**Suggested Reading:**

1. Kumar, V. Abbas, A.K. (2014). Robbins & Cotran Pathologic Basis of Disease. Ninth Edition. Elsevier, Saunders.
2. Basu P. Biochemistry Laboratory Manual. Academic Publishers.
3. Jayaraman, J. Laboratory Manual in Biochemistry. 2nd Edition. New Age International Publisher.
4. Kumar, V. Abbas, A.K. (2014). Robbins & Cotran Pathologic Basis of Disease. Ninth Edition. Elsevier, Saunders.
5. Basu P. Biochemistry Laboratory Manual. Academic Publishers.
6. Jayaraman, J. Laboratory Manual in Biochemistry. 2nd Edition. New Age International Publisher.
7. Note Books on Practical Biochemistry. Published by The Physiological Society of India. Kolkata.
8. Rao, S. Practical Biochemistry in Medicine. Academic Publishers.
9. Pelczar, M.J. (2001) Microbiology. 5th edition, Tata McGraw-Hill Co, New Delhi.
10. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
11. Mukherjee, K.L. (2004). Medical Laboratory Technology. Vol. I, Vol. II and Vol. III. Tata McGraw-Hill.
12. Hinkle, J.L. Kerry H. Cheever, K.H. (2013). Brunner & Suddarth's Handbook of Laboratory and Diagnostic Tests. 2nd Edition. LWW Publisher.
13. Godkar, P.B. Godkar. O.D.(2014). Textbook of Medical Laboratory Technology. 14th Edition.
14. Chattopadhyay P. (2011). Practical Physiology. 1st Edition. New Central Book Agency.
15. Manna, M.K. (2005). Practical Physiology. 1st Edition. Sritara Prakashani.
16. Debnath J. (2008). Babaharik Sharir Bigyan. Shreedhar Prokashani, Kolkata.
17. Magdeldin, S. (2012). Gel Electrophoresis - Principles and Basics. IntechOpen.



6. General Elective Course



SEMESTER-I

6.1 GE T1 – Cellular Components, Biophysical and Biochemical Concepts

Course Code: SH/PHY/103/GE-1

Course ID: 12514

[Theory: Credit 4 (4 lectures/Week)/ Marks 25]

4 Credits

Course Learning Outcomes:

- This course gives a broad knowledge about cellular structure, functions of cell organelle and plasma membrane.
- From this course students will learn the knowledge about different type of tissues and their functions.
- The course would fortify to the students to acquire the knowledge about physiological importance of biophysical processes.
- They acquire a concept about enzymes and chemistry of biomolecules.
- Student will learn about enzyme kinetics with special reference to Michaelis Menten equation and hyperbolic kinetics.

Units of Human System

1. Introduction to Human Physiology.
2. Structure and functions of plasma membrane, nucleus and different cell organelles - Endoplasmic reticulum, Golgi bodies, mitochondria, ribosome, lysosome and peroxisome.
3. Structure, function and classification of epithelial, connective, muscular and nervous tissues.

Biophysical Principles

1. Physiological importance of biophysical processes: Diffusion, osmosis, dialysis, ultra filtration, surface tension, absorption and adsorption.
2. pH and Buffers: Brief idea and significance in human body.
3. Colloids: Definition, classification, properties and physiological importance.



Enzyme

1. Definition, classification and factors affecting enzyme action.
2. Michaelis Menten equation and hyperbolic kinetics of enzyme action in brief.
3. Regulation of enzyme action in brief.
4. Concept of coenzymes and isozymes.

Chemistry of Bio-molecules

1. Carbohydrates: Definition, classification with examples, sources, fundamental properties, and physiological importance.
2. Lipids: Definition, classification, properties and physiological importance.
3. Proteins: Definition, classification, important properties and function. Essential and non-essential amino acid.
4. Nucleic acids: Structure of DNA and RNA.



6.2 GE P1: Cellular Components, Biophysical and Biochemical Concepts Lab

Course Code: SH/PHY/103/GE-1

Course ID: 12524

(Practical: Credits 2/ Marks 15)

2 Credits

Course Learning Outcomes:

- From this course students will acquire their knowledge about various parts of microscope.
- They will gain elementary idea on permanent slide preparation.
- This practical course will provide wide range of knowledge about histological structure of different organs.

Identification of permanent slides and Fresh tissue preparation

1. Elementary idea of compound microscope and its use.
2. Introductory discussion on preparation of permanent slide.
3. Lung, trachea, spleen, lymph gland, liver, salivary glands, pancreas, esophagus, stomach, small intestine, large intestine, ovary, adrenal gland, testis, thyroid gland, spinal cord, cerebellum, cerebral cortex, kidney, skin and tongue – Identification with characters.

Experiment on fresh tissues

Preparation and staining of fresh tissue: Squamous and skeletal muscle fibre by methylene blue stain.



Suggested Readings

1. Rastogy, S. C. (2005). Cell and Molecular Biology. New Age International Publishers.
2. Das, D. (2008). Biochemistry. Academic Publishers.
3. Das, D. (2004). Biophysics and Biophysical Chemistry. Fifth Edition. Academic Publishers
4. Satyanarayana, U. and Chakrapani. U. (2013). Biochemistry. 4th Edition. Elsevier India.
5. Keele, C.A., Neil, E., Toels N. (1982). Samson Wright's Applied Physiology. Thirteenth Edition. Oxford University Press.
6. Mescher, A.L.(2013). Junqueira's Basic Histology Text and Atlas. Thirteen Edition. The Tata McGraw Hill Companies.
7. Ross , M.H, and Reith, E.J. (2011). Histology - A Text and Atlas. Sixth Edition. The Williams and Wilkins Company.
8. Bailey's Text Book of Histology, revised by W.M. Copenhaver; The Williams and Wilkins Company
9. Eroschenko, V.P. (2012). Difiore's Atlas of Histology: With Functional Correlations. Twelfth Edition. Lippincott Williams Wilkins Company.
10. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education, Inc. U.S.A. 8th edition.
11. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
12. Mahapatra, A.B.S.M. (2014). Essentials of Medical Physiology. Forth Edition. Current Books International.
13. K Sembulingam, K. and Sembulingam, P. (2016). Essentials of Medical Physiology 7th Edition. Jaypee.
14. Khurana, I. (2015). Medical Physiology. 2nd Edition. Elsevier India.
15. Chatterjee, C.C. (2016). Human Physiology Volume 1. Eleventh Coloured Edition. CBS. Publishers and Distributers Pvt. Ltd.
16. Chaudhuri, S.K.(2008). Concise Medical Physiology. Sixth Edition. NCBA.
17. Roy, R.N. A.(2015). Text Book of Biophysics. New Central Book Agency (P) Ltd.
18. Bandopadhyay A. Snatak Sarir Bidya (2018) (Based on CBCS Curriculum for Semester I & II). Calcutta Book House Pvt. Ltd.
19. Masanta N and Das T. (2019) Snatak Sarirbidya. (UG CBCS syllabus) Vol I. Santra Publication Pvt. Ltd
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23. Dhara, P. (2006). Computer in Biological Science Book. Academic Publishers.
24. Salaria, R.S. (2017). Computer Fundamentals. Khanna Book Publishing



SEMESTER-II

6.3 GE T2 - Blood, Cardio-respiratory and Neuromuscular Systems

Course Code: SH/PHY/203/GE-2

Course ID: 22514

[Theory: Credit 4 (4 lectures/Week)/ Marks 25]

4 Credits

Course Learning Outcomes:

- This paper helps to learn about components of blood and their functions along with synthesis of hemoglobin.
- Student will be able to learn about cardiorespiratory functions and nerve muscle physiology.
- From this course learners will gather knowledge about mechanism of blood coagulation and related factors.
- They will acquire the knowledge about the respiratory system and nerve muscle physiology along with their mechanism of action.

Blood and Body Fluid

1. Blood: Composition, functions, plasma and serum.
2. Plasma proteins: Origin, classification and functions.
3. Blood cells: Morphology and functions.
4. Erythropoiesis: Different stages, factors affecting and fate of RBC.
5. Anaemia: Types (Definition and causes).
6. Haemoglobin: Types, biosynthesis, functions and derivatives.
7. Coagulation of blood: Coagulation factors, mechanism of coagulation, procoagulants and anticoagulants.
8. Lymph and tissue fluids: Composition, formation, and functions.
9. Blood groups: ABO system and Rh typing. Blood transfusion and its hazards.



Cardiovascular Physiology

1. Anatomy of the heart.
2. Properties of cardiac muscle.
3. Origin and propagation of cardiac impulse.
4. Cardiac cycle: Events, heart sounds and heart rate.
5. Cardiac output: Determination by Fick principle and factors affecting.
6. Blood pressure and its regulation and factors controlling.
7. Methods of measurement of blood pressure.
8. Peculiarities of regional circulations: Coronary and cerebral.
9. Myocardial ischemia and heart block.

Respiratory Physiology

1. Functional anatomy of the respiratory system.
2. Mechanism of breathing. Significance of physiological and anatomical dead space. Lung volumes and capacities.
3. Transport of oxygen and carbon dioxide in blood and tissue.
4. Regulation of respiration: Neural and chemical.
5. Hypoxia, Caisson's disease, cyanosis, anoxia and acclimatization in brief.

Neuro-muscular System

1. Structure of neurons.
2. Origin and propagation of nerve impulse.
3. Properties of nerve fibers: Excitation, conduction, All or none law and refractory period.
4. Synapses: Types, EM structure, mechanism of synaptic transmission. Motor unit and motor point.
5. Myoneural junction - Structure, mechanism of impulse transmission. Degeneration and regeneration in nerve fibers.
6. Different types of muscle and their structure. Red and white muscle. Muscular contraction: Structural, mechanical and chemical changes in skeletal muscle during contraction and relaxation. Isotonic and isometric contractions.
7. Properties of muscle - All or none law, beneficial effect, summation, refractory period, rheobase and chronaxie, tetanus and fatigue.



6.4 GE P2: Blood, Cardio-respiratory and Neuromuscular Systems Lab

Course Code: SH/PHY/203/GE-2

Course ID: 22524

(Practical: Credits 2/ Marks 15)

2 Credits

Course Learning Outcomes:

- From this course students will acquire skill on different hematological techniques.
- They will develop their concept on capacity related lung function parameters and its associated abnormalities.

Haematological experiments

1. Preparation and staining of human blood film with Leishman's stain and identification of different types of blood corpuscles.
2. Determination of blood group: ABO system and Rh factor.
3. Preparation of haemin crystals.
4. Determination of clotting time and bleeding time.

Lung function tests

Measurement of TV and VC by spirometer.

Recording of chest movement by Pneumograph:

Pneumographic recording of effect of drinking water, talking, laughing, coughing, breath holding and hyperventilation.



Suggested Readings

1. Mahapatra, A.B.S. (2011). Essentials of Medical Physiology Practical. First Edition. Current Books International.
2. Ghai, C.L. A Text Book of Practical Physiology. 8th Edition. Jaypee.
3. Hall J.E. (2016). Guyton & Hall Textbook of Medical Physiology. Second South Asia Edition.
4. Mahapatra, A.B.S. (2014). Essentials of Medical Physiology. Forth Edition. Current Books International.
5. Sembulingam, K. and Sembulingam, P. (2016). Essentials of Medical Physiology 7th Edition. Jaypee.
6. Khurana, I. (2015). Medical Physiology. 2nd Edition. Elsevier India.
7. Chatterjee, C.C. (2016). Human Physiology Volume 2. Eleventh Coloured Edition. CBS. Publishers and Distributers Pvt. Ltd.
8. Chaudhuri, S.K.(2008). Concise Medical Physiology. Sixth Edition. NCBA.
9. Charles Nobach .The Human Nervous System. Mc Graw Hill Book Co.
10. Berne , R.M. and Levy M.N. Physiology. C.V.Mosby Co.
11. Guyton, A.C. Hall, J.E. (2007) Text Book of Medical Physiology. Eleventh Edition. W.B. Saunders Co.
12. Barrett, K. E. Barman, S.M., Boitano, S. Brooks, H.L. (2012). Ganong's Review of Medical Physiology. 24th Edition. Lange Medical Book. Prentice-Hall International.
13. Pal, G.K. Pal, P. (2013).Textbook of Practical Physiology. Third Edition. Universities.
14. Shepherd.G.M. Neurobiology. Oxford University Press.
15. Chadha, P.V. Handbook of Experimental Physiology and Biochemistry. Jaypee Brothers Medical Publishers.
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18. Debnath J. (1998). Sharir Bignan. Vol.I & II. Shreedhar Prokashani, Kolkata.
19. Debnath, J. Byabaharik Sharir Bignan. Shreedhar Prokashani, Kolkata.

**SEMESTER-III****6.5 GE T3 - Digestion, Metabolism, Nutrition and Excretion**

Course Code: SH/PHY/304/GE-3

Course ID: 32514

[Theory: Credit 4 (4 lectures/Week)/ Marks 25]

4 Credits

Course Learning Outcomes:

- From this core course students will gather knowledge about digestion and absorption of principle food stuff.
- They will develop their knowledge in carbohydrate, protein and fat metabolism and their integrated pathway.
- Student will develop their knowledge about basic components of food with their nutritional values along with nutritional assessment in different food stuff.
- Developing the knowledge how excretory system functioning.

Digestive system:

1. EM structure of alimentary canal and digestive glands.
2. Movements of the alimentary canal and significance. Mastication and deglutition.
3. Composition and functions of digestive juices and bile.
4. Mechanism of secretions HCl and bile.
5. Digestion and absorption of carbohydrate, protein and lipid.

Metabolism

1. Metabolism of carbohydrate: Glycogenesis in brief, glycolysis, glycogenolysis, gluconeogenesis, pentose phosphate pathway, TCA cycle and Cori cycle – Their significances.
2. Metabolism of lipids: Fatty acid bio synthesis, lipolysis, Beta oxidation and omega oxidation of fatty acids. Brief ideas on fat storage and adipose tissue.
3. Formation and fate of ketone bodies. Lipoprotein – Classification and their importances.
4. Metabolism of proteins: Elementary idea of protein synthesis, transamination, oxidative and non-oxidative deamination. Formation of urea.
5. Integration of carbohydrate, lipids and protein metabolism in brief.

Nutrition

1. Basic constituents of food and their nutritional significance, dietary fiber and its importance.
2. Vitamins: Definition, sources, daily requirements, functions, deficiency symptoms and hypervitaminosis.



3. Mineral metabolism: Ca, P and Fe (Source, absorption and physiological function).
4. BMR: Definition, factors affecting and determination by Benedict-Roth apparatus. Respiratory quotient: Definition, factors affecting and significance.
5. Brief idea on: Nitrogen balance, biological value of proteins, digestibility coefficient, net protein utilization, protein efficiency ratio. Supplementary action of protein, specific dynamic action, protein sparing food.
6. RDA, Adult Consumption Unit and NPN.
7. Basic principle and methods for diet chart preparation.
8. Diet chart preparation - College student, pregnant and lactating mother.

Excretory system

1. Anatomical organization of urinary system. Gross structure of kidney.
2. Renal circulation: Anatomy and peculiarities.
3. Microanatomy (Including electron microscopy) of a nephron and structure differences between cortical and juxtamedullary nephrons. Juxtaglomerular apparatus.
4. Mechanism of formation of urine. Concept of ultrafiltration, glomerular filtration rate. Passive and active tubular transport.
5. Innervation of urinary bladder in brief, filling of bladder.
6. Micturition. Micturition reflexes, diuresis and role of ADH (In brief).
7. Normal and abnormal constituents of urine and their significance. Concept of renal threshold. Functions of kidney and renal function tests (inulin and urea clearance tests).
8. Non-excretory functions of kidney.



6.6 GE P3: Digestion, Metabolism, Nutrition and Excretion Lab

Course Code: SH/PHY/304/GE-3

Course ID: 32524

(Practical: Credits 2/ Marks 15)

2 Credits

Course Learning Outcomes:

- This practical paper will help to increase the ability of students in qualitative and quantitative importance of physiologically important biomolecules.
- Student will develop their skill in the titration process with high level of accuracy.

Qualitative Experiments

1. Qualitative tests for the identification of physiologically important substances: Hydrochloric acid, lactic acid, glucose, fructose, lactose, sucrose, starch, albumin, peptone, urea, acetone, glycerol, bile salts - Systematic analysis and confirmatory test.

Quantitative Experiments

1. Quantitative estimation of glucose by Benedict's method - Percentage and total quantity.
2. Quantitative estimation of amino nitrogen (Sorensen's Formol titration method) - Percentage and total quantity.

Suggested Readings

1. Srilakshmi, B. (2016). Nutrition Science. Fifth Edition. New Age International Publishers.
2. Srilakshmi, B. (2014). Dietetics. Seventh Edition. New Age International Publishers.
3. Das S. Textbook of Normal and Therapeutic Nutrition. Academic Publishers.
4. Das S. (2016).Textbook of Community Nutrition. 2nd Edition. Academic Publishers.
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6. Srilakshmi, B. (2015). Food Science. Sixth Edition. Age International Publishers.
7. Swaminathan, M. (2012). Handbook of Food and Nutrition. Jain Book Agency.
8. Swaminathan, M. (2015). Essentials of Food and Nutrition. Vol. I AND Vol. II. The Bangalore Printing and Publishing Co., Ltd.
9. Chatterjee, C.C. (2016). Human Physiology Volume 1. Eleventh Coloured Edition. CBS. Publishers and Distributers Pvt. Ltd.
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12. Sembulingam, K. and Sembulingam, P. (2016). Essentials of Medical Physiology 7th Edition. Jaypee.



13. Khurana, I. (2015). Medical Physiology. 2nd Edition. Elsevier India.
14. Berne , R.M. and Levy M.N. Physiology. C.V.Mosby Co.
15. Guyton, A.C. Hall, J.E. (2007) Text Book of Medical Physiology. Eleventh Edition. W.B. Saunders Co.
16. Barrett, K. E. Barman, S.M., Boitano, S. Brooks, H.L. (2012).Ganong's Review of Medical Physiology. 24th Edition. Lange Medical Book. Prentice-Hall International.
17. Pal, G.K. Pal, P. (2013).Textbook of Practical Physiology. Third Edition. Universities.
18. Shepherd.G.M. Neurobiology. Oxford University Press.
19. Chadha, P.V. Handbook of Experimental Physiology and Biochemistry. Jaypee Brothers Medical Publishers.
20. Bandopadhyay A. Snatak Sarir Bidya (2018) (Based on CBCS Curriculum for Semester I & II). Calcutta Book House Pvt. Ltd.
21. Masanta N and Das T. (2019) Snatak Sarirbidya. (UG CBCS syllabus) Vol I & II Santra PublicationPvt. Ltd.
22. Debnath, J. (1998). Sharir Bigyan. Vol. I & II. Shreedhar Prokashani, Kolkata.
23. Debnath, J. Byabaharik Sharir Bignan. Shreedhar Prokashani, Kolkata.



SEMESTER-IV

6.7 GE T4 - Neurosensory, Endocrine and Reproductive Systems

Course Code: SH/PHY/404/GE-4

Course ID: 42514

[Theory: Credit 4 (4 lectures/Week)/ Marks 25]

4 Credits

Course Learning Outcomes:

- Student will acquire their knowledge about structure and function of nervous system and their higher centre for controlling different sensory and motor activities.
- From this course student will learn about structure and functions of special sensory organs.
- Learner will develop their understanding on the basic concept on endocrine system anatomically and histologically.
- To gather knowledge about chemical messenger actions in physical and chemical coordinated function in our body including hyper and hypoactive conditions.
- They will develop important information about male and female reproductive systems.

Nervous System

1. A brief outline on organization and basic functions of (Sensory, motor and association) the nervous system.
2. Histology of spinal cord.
3. Origin, course, termination and functions of – Goll and Burdach tract, spino-thalamic tract, cortico-spinal tract and pyramidal tract.
4. Reflex action - Definition, reflex arc, classification, properties and function.
5. A brief idea of the structure and functions of cerebellum.
6. Functions of thalamus and hypothalamus.
7. Cerebral cortex: Histological structure and functions.
8. CSF - Composition, formation and functions.
9. A brief description of the organization of the autonomic (Sympathetic and parasympathetic) nervous system. Functions of sympathetic and parasympathetic nervous system.



Sensory Physiology

1. Audition: Structure of ear, auditory pathway, mechanism of hearing. Deafness in brief.
2. Vision: Structure of the eye. Histology of retina. Visual pathway. Light reflex. Chemical changes in retina on exposure to light. Accommodation - Mechanism. Errors of refraction. Light and dark adaptation.
3. Elementary idea of colour vision and colour blindness.
4. Olfaction and gustation: Structure and function of receptor organs, neural pathway. Olfactory and gustatory adaptation. After taste.

Endocrine System

1. Hypothalamus: Location, Hypothalamo-hypophyseal-endocrine axis and portal system. Releasing factors, in brief. Basic concept of neurohormone.
2. Pituitary: Histological structure, hormones and functions.
3. Thyroid: Histological structure, functions of thyroid hormones (T_3 and T_4). Thyrocalcitonin. Hypo and hyper-active states of thyroid.
4. Parathyroid: Histological structure, functions of parathyroid hormone.
5. Adrenal gland: Histological structure and function.
6. Pancreas: Histology of islets of Langerhans. Origin and functions of pancreatic hormones.
7. Brief idea of gastrointestinal hormone.
8. Cause of major pathophysiology of endocrine gland in brief (Gigantism, dwarfism, acromegaly, goiter, tetany, Cushing's syndrome and diabetes mellitus).

Reproductive Physiology

1. Primary and accessory sex organs. Secondary sex characters.
2. Puberty- Physiological changes.
3. Testis: Histology, spermatogenesis, hormonal control, testicular hormones and their functions.
4. Ovary: Histology, oogenesis, hormonal control. Ovarian hormones and their functions.
5. Menstrual cycle and its hormonal control.
6. Development of mammary gland and lactation - Role of hormones.
7. Fertilization and implantation.
8. Pregnancy: Physiology and hormonal control.



6.8 GE P4: Neurosensory, Endocrine and Reproductive Systems Lab

Course Code: SH/PHY/404/GE-4

Course ID: 42524

(Practical: Credits 2/ Marks 15)

2 Credits

Course Learning Outcomes:

- The readers will be able to measure visual function with different errors and their preventive measures.
- Student will develop their skill on histology related laboratory staining techniques and identification of respective male and female reproductive tissues.
- This practical paper helps our students how to handle kymograph.
- Lerner will grow their knowledge about pathophysiological state on hyper and hypo active states of endocrine glands.

1. Kymograph and its accessories.
2. Recording of simple muscle curve with sciatic-gastrocnemius muscle preparation of toad.
3. Determination of visual acuity by Snellen's chart / Landolt's C chart.
4. Determination of colour blindness by Ishihara chart. Exploration of conductive and perceptive deafness by tuning fork method.
5. HE staining and identification of testis and ovary of supplied paraffin embedded tissue section.
6. Sign, symptoms and reasons of pathophysiological state of the photograph provided within the syllabus on hyper and hypo active states of endocrine glands.



Suggested Readings:

1. Chatterjee, C.C. Human Physiology Vol. 1 & 2, Medical Allied Agency.
2. Debnath J. Sharirbigyan (Bengali) Vol. I & 2. Sridhar Prakashani.
3. Pramanik, D. Principles of Physiology. Academic Publishers, Kolkata.
4. Chaudhuri, S.K. Concise Medical Physiology. New Central Book Agency.
5. Bandopadhyay, A. Snatok Sharirbidya, , Calcutta Book House.
6. diFiore's Atlas of Histology, V.P. Eroschenko, Wolters-Kluwer
7. Shaver, L.G. Essentials of Exercise Physiology. Surjeet Publications.
8. Guyton, C. Text Book of Medical Physiology, W.B. Saunders Co.
9. Venkatesh, D. Sudhakar, H.H. Textbook of Medical Physiology, Wolters Kluwer
10. Khurana, I. Textbook of Medical Physiology, Elsevier
11. Mahapatra, A.B.S. Medical Physiology. Current Books International.
12. Sembulingam, K. Sembulingam, P. Essentials of Medical Physiology. Jaypee Brothers Medical Publishers Pvt. Ltd.
13. Manna, M.K. Practical Physiology. Sritara Prakashani, Kolkata.
14. Bandopadhyay A. Snatak Sarir Bidya (2018) (Based on CBCS Curriculum for Semester I & II). Calcutta Book House Pvt. Ltd.
15. Masanta N and Das T. (2019) Snatak Sarirbidya. (UG CBCS syllabus) Vol II. Santra Publication Pvt. Ltd.
16. Debnath, J. (1998). Sharir Bignan. Vol. II. Shreedhar Prokashani, Kolkata.
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