Syllabus and Scheme of Examination
For

3-year B.Sc. (Honours & Generic) in Physiology

Under Choice Base Credit System (CBCS)

(I-VI SEMESTER)

2018

Department of Physiology (UG)

Raja N. L. Khan Women's College (Autonomous)

Structure of the Syllabus

B. Sc. (Honours & Generic) in Physiology

[Choice Based Credit System]

Semester – I

Course Type	Course Code	Course Title	Credit	Total Class Hours	Marks		
					Internal Assessment +Attendance	End Semester Examination (ESE)	Course Total
Core-1	CC1T+ CC1P	Cellular basis of Physiology and Human Anatomy	6	75	15	60	75
Core-2	CC2T+ CC2P	Chemistry of Biomolecules	6	75	15	60	75
Generic Elective (Interdisciplinary for other departments)	GE1T+ GE1P	Cellular Basis of Physiology, Biophysical Principles, Enzymes and Chemistry of Bio-molecules Digestion, Absorption & Metabolism. Blood and Body Fluids, Cardiovascular System, Respiratory System.	6	75	15	60	75
Ability Enhancement Compulsory Course (AECC)	AECC-1	English/Modern Indian Language	2	50	10	40	50
Semester -I : Total			**20**				**275**

Semester – II

Course Type	Course Code	Course Title	Credit	Total Class Hours	Marks		
					Internal Assessment +Attendance	End Semester Examination (ESE)	Course Total
Core-3	CC3T+ CC3P	Blood & Body fluid, Biophysics	6	**75**	15	60	75
Core-4	CC4T+ CC4P	Nerve muscle Physiology	6	**75**	15	60	75
Generic Elective (Interdisciplinary for other departments)	GE-2T+ GE2P	Nerve-muscle Physiology, Nervous System. Endocrinology, Reproductive Function Excretory Physiology	6	**75**	15	60	75
Ability Enhancement Compulsory Course (AECC)	AECC-2	ENVS	4	50	20	80	100
Semester -II: Total			**22**				**325**

Semester – III

Course Type	Course Code	Course Title	Credit	Total Class Hours	Marks		
					Internal Assessment +Attendance	End Semester Examination (ESE)	Course Total
Core-5	CC5T + CC5P	Cardiovascular System	6	75	15	60	75
Core-6	CC6T + CC6P	Respiratory System	6	75	15	60	75
Core-7	CC7T + CC7P	Alimentary system and Excretory system	6	75	15	60	75
Skill Enhancement Course (SEC)	SEC-1	Hematological Techniques OR Clinical biochemistry	2	40	10	40	50
Generic Elective (Interdisciplinary for other departments)	GE-3T+ GE-3P	Cellular Basis of Physiology, Biophysical Principles, Enzymes and Chemistry of Bio-molecules Digestion, Absorption & Metabolism. Blood and Body Fluids, Cardiovascular System, Respiratory System.	6	75	15	60	75
Semester -II: Total			**26**				**350**

Semester – IV

Course Type	Course Code	Course Title	Credit	Total Class Hours	Marks		
					Internal Assessment +Attendance	End Semester Examination (ESE)	Course Total
Core-8	CC8T+ CC8P	Digestion &Metabolism	6	75	15	60	75
Core-9	CC9T+ CC9P	Nutrition & Dietetics	6	75	15	60	75
Core-10	CC10T+ CC10P	Nervous System	6	75	15	60	75
Skill Enhancement Course (SEC)	SEC-2	Applied food sciences OR Fundamentals of computer and Bioinformatics	2	30	10	40	50
Generic Elective (Interdisciplinary for other departments)	GE-4T+ GE-4P	Nerve-muscle Physiology, Nervous System. Endocrinology, Reproductive Function Excretory Physiology	6	75	15	60	75
Semester -IV: Total			**26**				**350**

Semester – V

Course Type	Course Code	Course Title	Credit	Total Class Hours	Marks		
					Internal Assessment +Attendance	End Semester Examination (ESE)	Course Total
Core-11	CC11T+ CC11P	Special senses and body temperature regulation	6	75	15	60	75
Core-12	CC12T+ CC12P	Genetics, Molecular Biology Biotechnology	6	75	15	60	75
Discipline Specific Elective (DSE)-1	DSE-1T+ DSE-1P	DSE-A: (one course in semester 5 & one course in semester 6) 1.Biostatistics & computational biology 2.Microbiology & Immunology 3. Advanced Molecular biology & Nanotechnology 4.Community and social medicine	6	75	15	60	75
Discipline Specific Elective (DSE)-2	DSE-2T+ DSE-2P	DSE –B: (one course in semester 5 & one course in semester 6) 1. Application of instruments in study of physiology 2.Work and sport physiology and Ergonomics 3. Toxicology &Pharmacology 4. Stress Physiology, Yoga and meditation.	6	75	15	60	75
Semester -V: Total			**24**				**300**

Semester – VI

Course Type	Course Code	Course Title	Credit	Total Class Hours	Marks		
					Internal Assessment +Attendance	End Semester Examination (ESE)	Course Total
Core-13	CC13T+ CC13P	Endocrinology and Chronobiology	6	75	15	60	75
Core-14	CC14T+ CC14P	Reproductive Physiology & Developmental Biology	6	75	15	60	75
Discipline SpecificElectives (DSE)-3	DSE-3T+ DSE-3P	DSE-A: (one course in semester 5 & one course in semester 6) 1.Biostatistics & computational biology 2.Microbiology & Immunology 3. Advanced Molecular biology & Nanotechnology 4.Community and social medicine	6	75	15	60	75
Discipline SpecificElectives (DSE)-4	DSE-4T+ DSE-4P	DSE –B: (one course in semester 5 & one course in semester 6) 1. Application of instruments in study of physiology 2.Work and sport physiology and Ergonomics 3. Toxicology &Pharmacology 4. Stress Physiology, Yoga and meditation.	6	75	15	60	75
Semester -V: Total			**24**				**300**

Outcome of the Academic Programme on3-Year B.Sc. in Physiology

Program Outcome: Bachelor of Science

- ✓ Bachelor of Science offers theoretical as well as practical knowledge about different subject areas.
- ✓ This course forms the basis of science for coherent understanding of the academic field to pursue multi and interdisciplinary science careers in future.
- ✓ These subject areas include Physics, Chemistry, Mathematics, Computer Science and Botany, Physiology and Zoology.
- ✓ Able to plan and execute experiments or investigations, analyze and interpret data information collected using appropriate methods.
- ✓ It helps to develop scientific temper and thus can prove to be more beneficial for the society as the scientific developments can make a nation or society to grow at a rapid pace through research.
- ✓ Think critically, follow innovations and developments in science and technology.

Program Specific Outcomes: B.Sc. in Physiology (Honours and General)

On completion of the 3-year B.Sc. in Physiology programme:

1. Students will learn about basic biochemistry and biophysical processes in human systems and importance of digestion, metabolism and molecular biology.

2. Students will learn about cell and tissues, blood and body fluids, anatomy and mechanism of function of cardiovascular system and also the processes involved in respiratory system.

3. Students will learn about neurons, nervous system and special senses and their mechanism of actions.

4. Students will learn about hormones, different types of glands, mechanism of functions involved in processes involved in reproductive and renal organs.

5. Students will learn about blood related disorders, their causes, prevention and treatments.

6. Students will be able to distinguish, determine and detect additives and adulterants in common foods and also the hazardous effects of these on human and environment

7. All the students will be able to perform various important practical related to human physiology.

8. Students shall acquire skills needed to conduct research studies relevant and beneficial to the society. The way the course work is structured, students will certainly go a long way to impart sufficient skills and information which will enhance students' employability, make them conscious and understand their own body better.

Prospects and Career Options

The field of Physiology has a long history of two-way interactions with clinical medicine. Dealing with therapy, exercise or investigation, this branch is works to support medicine. So, if medical science interest you, but you don't want to go the traditional route and become a doctor, then physiology may have a number of varied career options to offer.

A physiologist studies the human body and how the organs and systems coordinate together under normal and abnormal conditions, at both cellular and molecular levels. They then use this knowledge of the human body to support traditional medical therapy.

Physiologists can have their areas of specialization and can go on to pursue advanced degree in those specialized fields. The major ones are Clinical Physiology, Cell Physiology, and Exercise Physiology.

Mostly physiologists have got a vast array of opportunities in the medical industry. But they can also be employed in the academic and science industries, or by private companies and the government.

Physiology graduates also have an excellent grounding to study for further qualifications in areas such as medicine or teaching.

The career options in Physiology: Audiologist, Biomedical Scientist, Cytologist, Immunologist, Forensic Scientist, Epidemiologist, Laboratory Technician, Pharmacologist, Pharmacist, Lecturer, Research Associate, Physiologist, Teacher, Virologist, Clinical Physiologist, Clinical Research Associate, etc.

Semester –I

CC1T: Cellular basis of Physiology and Human Anatomy:

Cellular Basis of Physiology Cell Structure and function--Electron microscopic structure and functions of Nucleus, endoplasmic reticulum, ribosomes, Golgi bodies, mitochondria, lysosomes, peroxisomes, cytoskeletal elements, centrosomes and plasma membrane. Cellular transport—Passive and active transport. Ion channels, ionophores. Intercellular communication--- Basic idea of tight junctions, gap junctions, adherens, junctions, desmosomes and cell adhesion molecules. Extracellular matrix components.

Enzyme:

Classification-EC nomenclature, Concept of apoenzyme, holoenzyme, coenzyme, cofactors and prosthetic group. Brief concept about mechanism of enzymes action. Michaelis constant, Michaelis-Menten equation, Graphical representation of hyperbolic kinetics-- Lineweaver Burk plot. Significance of Km and Vmax. Factors influencing enzyme-catalyzed reactions: substrate concentration, enzyme concentration, pH, temperature. Competitive, noncompetitive and uncompetitive inhibitions. Regulation of enzyme activities--covalent modifications, allosteric modifications: K- and M- series. Feed-back inhibition. Rate limiting enzymes. Isozymes, Ribozymes and Abzymes.

CC1P: Study of Microscope, Staining of squamous epithelium, Adipose tissue, skeletal. Muscle, & Node of Ranvier. Determination of optimum pH temperature of amylase by DNSA method.

CC2T: Chemistry of Biomolecules.

Carbohydrates: Definition and classification. Monosaccharides–¬ Classification, structure, stereoisomerism, optical isomerism, optical activity, epimerism. Cyclic structures- Pyranose and furanose forms, anomerism, mutarotation. Chemical reactions of monosaccharides (Glucose & Fructose) ---- Reactions with concentrated mineral acids, alkali, phenylhydrazine. Derivatives of monosaccharides and their physiological importance. Disaccharides – Maltose, Lactose and Sucrose: Structure, Occurrence and Physiological importance. Polysaccharides – Starch, Glycogen, Dextrin, Cellulose, Glycosaminoglycans, Glycoproteins, Sialic acids.

Lipids: Definition and classification. Fatty acids - Classification, systemic nomenclature–¬ and structure. Mono-, Di- and Triglycerides. Properties of Fat and Fatty acids Hydrolysis, Saponification number, Iodine number, Acetyl number, Acid number, Reichert-Meissl number. Cis-trans isomerism. Eicosanoids, Phospholipids, Glycolipids,

Sphingolipids, Cholesterol & its ester ---- their structure and physiological importance. Lipoproteins – classification and functions.

Amino acids: Classification, Structure, properties, Protonic equilibria of amino acids – Zwitterions, Isoelectric point, titration curve of amino acids. Reactions with ninhydrin and formaldehyde. Peptides and Proteins: Structure and properties of peptide bonds -- Phi¬ and Psi angles. Reactions with Sanger's and Edman's reagent. Biuret reaction. Different levels of protein structure -- Primary, Secondary (α-helix and β-pleated sheet), Tertiary and Quaternary. Forces stabilizing the structures. Denaturation and Renaturation. Purine and Pyrimidine: Structure, nomenclature and tautomerism.

Nucleic acids: Nucleosides and Nucleotides -- structure. Polynucleotides. DNA double helix model. DNA polymorphism: A-DNA, B-DNA and Z-DNA. RNA – Structure, types and functions

CC2P: Qualitative tests for the identification of physiologically important substances: Hydrochloric acid, Lactic Acid, Uric Acid, Albumin, Gelatin, Peptone, Starch, Dextrin, Glucose, Fructose, Lactose, Sucrose, Urea, Acetone, Glycerol and Bile salts, Biochemical estimation of glucose by Nelson Somogyi method, Amino nitrogen by formol titration method, Sucrose by Benedict's method

Course Outcome: Understanding the physiology of human systems is important as human are the most developed species on earth till now. Students will able to understand the structures of each cell organelle and explain their functions inside a cell and its overall functionality in respect to whole body system. Biophysical Principles, Enzymes and Chemistry of Bio-molecules. Interpret and understand simple physical processes like diffusion and osmosis and also complex processes like ultrafiltration and pH balance and their importance in a living cell. Understand some fascinating features like colloids and enzymes. Gain knowledge about most important chemicals- carbohydrates, proteins and fats. They will be able to understand their structural and functional relationship, classify them based on many features and bond formation at molecular level and most importantly their physiological importance in a living cell. Understand structure and functions of DNA and RNA and differentiate between them.

Practical and Demonstration classes provide a careerist approach for the students.

i) Students will be able to identify and distinguish between different epithelial cells in normal human body. ii) They will be able to identify some known and unknown bio-molecules which are most important in a living cell. iii) they will be able to measure percentage and total quantity of some specific biomolecules by titration method.

Generic Elective (GE)

[Interdisciplinary for other departments]

GE-1T (Generic): Cellular Basis of Physiology, Biophysical Principles, Enzymes and Chemistry of Bio-molecules Digestion, Absorption & Metabolism.

Cellular Basis of Physiology

Structure and functions of plasma membrane, nucleus and different cell organelles – Endoplasmic reticulum, Golgi bodies, Mitochondria, Lysosome and Peroxisome.

Biophysical Principles, Enzymes and Chemistry of Bio-molecules

Physiological importance of the following physical processes: Diffusion, Osmosis and Surface tension. pH and Buffers – Significance in human body and maintenance of pH in the blood. Colloids - Classification and physiological importance. Enzymes: Classification, factors affecting enzyme action. Concept of coenzymes and isozymes.

Carbohydrates: Definition and classification. Monosaccharides – Classification, structure, physiological importance. Disaccharides – Maltose, Lactose and Sucrose: Structure, occurrence and physiological importance. Polysaccharides – Starch, Glycogen, Dextrin, Cellulose. Lipids: Definition and classification. Fatty acids Classification. — Definition and importance of, Saponification number and, Iodine number. Phospholipids, Cholesterol & its ester -- physiological importance. Amino acids, Peptides and Proteins: Classification and structure. Structure of peptide bonds. Nucleic acids: Structure of DNA and RNA.

Digestion & Metabolism

Structure in relation to functions of alimentary canal and digestive glands. Composition, functions and regulation of secretion of digestive juices including bile. Digestion and absorption of carbohydrate, protein and lipid. Movements of the stomach and small intestine. 4 Glycolysis, TCA cycle, Importance of Glycogenesis, Glycogenolysis and. Gluconeogenesis. Beta oxidation of saturated fatty acid. Importance of Ketone bodies. Deamination & Transamination. Formation of urea.

Blood and Body Fluids Blood:

Composition and functions. Plasma proteins: origin and functions. Blood cells-- their morphology and functions. Erythropoiesis. Hemoglobin: different types of compounds and derivatives. Coagulation of blood: mechanism, procoagulants, anticoagulants. Lymph and tissue fluids: composition, formation, and functions.

Cardiovascular System

Anatomy and histology of the heart. Properties of cardiac muscle. Origin and propagation of cardiac impulse. Cardiac cycle: Events. Heart sounds. Heart rate. Cardiac output:

Determination by following Fick principle, factors affecting. Pulse - arterial and venous. Blood pressure and factors controlling. Baro- and chemoreceptors. Vasomotor reflexes. Peculiarities of regional circulations: coronary and cerebral.

Respiratory System

Anatomy and histology of the respiratory passage and organs. Role of respiratory muscles in breathing. Lung volumes and capacities. Exchange of respiratory gases between lung and blood and between blood and tissues. Transport of oxygen and carbon dioxide in blood. Regulation of respiration - neural and chemical. Hypoxia.

GE-1P: Examination and staining of fresh tissues: Squamous, Ciliated and Columnar Epithelium by Methylene Blue stain. Qualitative tests for identification of: Glucose, Fructose, Lactose, Sucrose, Starch, Dextrin, Lactic acid, Hydrochloric acid, Albumin, Acetone, Glycerol and Bile Salts. Quantitative estimation of amino nitrogen by Sorensen's formol titration method (percentage to be done).

Preparation and staining of human blood film with Leishman's stain and identification of different types of blood cells. Preparation of hemin crystals. Demonstration- kymographic recording of the unperfused heart of toad and effects of warm and cold saline.

Measurement of systolic and diastolic pressure by sphygmomanometer and determination of pulse and mean pressure. Measurement of peak expiratory flow rate. Pneumographic recording of normal respiratory movements and effects of hyperventilation and breath-holding.

Course Outcome: Students will get an overall idea on how the body and body systems work in co-ordination with each other. Through practical: i) Students will be able to identify blood cells in normal as well as different diseased and medico-legal conditions. ii) They will be able to understand mechanical changes of heart rhythm in response to temperature. iii) They will be able to measure blood pressure and interpret low or high B.P. iv) They will be able to measure lung functions in different physiological conditions and interpret normal and abnormal lung conditions.

Semester -II

CC3T: Blood &Body fluid, Biophysics

Bone marrow: Formed elements of blood–origin, formation, functions and fate. Plasma proteins Origin and functions. Erythropoiesis and its controlling factors. Leucopoiesis. Haemoglobin: Structure, reactions, biosynthesis and catabolism. Fetal hemoglobin. Abnormal hemoglobin- Sickle-cell anemia and Thalassemia. Blood volume: Regulation and determination by dye and radioisotope methods. Hemostasis: Factors, mechanism, anticoagulants, procoagulants. Disorders of hemostasis- Hemophilia, Thrombosis and Embolism. Blood group: ABO and Rh systems (Chemical nature of relevant biomolecules). Erythroblastosis fetalis. Blood transfusion and its hazards. Lymph and tissue fluids: Formation, circulation, functions and fate. Lymphatic organs: Histological structures and functions of lymph gland and spleen. Splenomegaly causes and effects. Circulatory disorder: Oedema.

Biophysical Principles: Diffusion: Its characteristics, factors influencing and physiological applications. Osmosis: Osmotic pressure – laws, and physiological applications. Surface tension¬ & viscosity: Physiological applications. pH & Buffer- Henderson-Hasselbach equation (quantitative problems). Determination of pH. Colloids: Classification, properties – optical, electrical, electrokinetic. Physiological¬ importance of colloids. Gibbs-Donnan membrane equilibrium.¬ Thermodynamics: Type of surroundings and systems. First Law– Internal energy,¬ enthalpy. Second Law – Entropy, Free energy change, Endergonic and Exergonic reactions, Reversible and Irreversible processes, Equilibrium constant. Physiological steady-state.

CC3P: Preparation of Blood film and identification of blood cells, TC; DC, Hb estimation (Cyan-methemoglobin method), hemin crystal, Measurement of diameter of neutrophil/ Megakaryocytes. Preparation of Buffer & pH measurement.

CC4T: Nerve muscle Physiology

Nerve: Structure, classification and functions of neurons and neuroglias. Cytoskeletal elements and axoplasmic flow. Myelinogenesis. The resting membrane potential. The action potential. Electrotonic potentials. Current of injury. Propagation of nerve impulse in different types of nerve fibers. Compound action potentials. Properties of nerve fibers: excitability, conductivity, all or none law, accommodation, adaptation, summation, refractory period, indefatigability. Chronaxie, rheobase and utilization time. Synapses: types, structure, synaptic transmission of the impulse, synaptic potentials, neurotransmitters, co-transmitters, neuromodulators. The neuromuscular junction: structure, transmission, end-plate potential, MEPP, post-tetanic

potentiation. Motor unit. Motor point. Injury to peripheral nerves – degeneration and regeneration in nerve fiber. Nerve growth factors.

Muscle: Electron microscopic structure of skeletal, smooth and cardiac muscles. The sarcotubular system. Red and white striated muscle fibers. Single-unit and multi-unit smooth muscle. Muscle groups: antagonists and agonists. Properties of skeletal muscle: excitability, contractility, all or none law, summation of stimuli, summation of contractions, effects of repeated stimuli, genesis of tetanus, onset of fatigue, refractory period, tonicity, conductivity, extensibility and elasticity. Length-tension relationship. Muscle proteins. Mechanism of skeletal and smooth muscle contraction and relaxation: Excitation-contraction coupling. Isometric and isotonic contractions. Chemical, thermal and electrical changes in skeletal muscle during contraction and relaxation. Electromyography.

CC4P: Study of kymograph, Nerve Muscle Preparation, Simple Muscle Curve, temperature, load, summation. Measurement of physical fitness by Harvard step test. Measurement of hand grip strength

Course Outcome: All the blood components are very important in detection of vast array of diseases as their characteristics change with every known disease. Students will learn about all these compositions and functions of all important body fluids, physiology of blood related diseases and their preventions. Students will be able to identify blood cells in normal as well as different diseased and medico-legal conditions. They would also learn about biophysical principles. Understand the extraordinary structure and functions of the neuro-muscular system. Distinguish between different types of neurons and muscles and how these different features are important for their respective functions. Learn coordination between functions of the neuron and muscle. Learn role of different cations and anions in generation of nerve impulse and its conduction throughout body. Understand the generation of electrical, chemical and mechanical impulse and how these are most important for a living system.

Generic Elective (GE)

[Interdisciplinary for other departments]

GE-2T: Nerve-muscle Physiology Nervous System, Endocrinology Reproductive Function Excretory Physiology

Nerve-muscle Physiology Nervous System

Nerve-muscle Physiology Structure of neurons. Origin and propagation of nerve impulse. Velocity of impulse in different types of nerve fiber. Properties of nerve fibers: all or none law, rheobase and chronaxie, refractory period. indefatigability. Synapses: structure, mechanism of

synaptic transmission. Motor unit. Myoneural junction: structure, mechanism of impulse transmission. Degeneration and regeneration in nerve fibers.

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. Properties of muscle: all or none law, beneficial effect, summation, refractory period, tetanus, fatigue.

Nervous System A brief outline of organization and basic functions (sensory, motor and association) of the nervous system, central and peripheral nervous system. Ascending tracts carrying touch, kinesthetic, temperature and pain sensations. Descending tracts: pyramidal tract and brief outline of the extra-pyramidal tracts. Reflex action - definition, reflex arc, classification, properties. Functions of the spinal cord. Outline of functions of brain stem. A brief idea of the structure, connections and functions of cerebellum. Different nuclei and functions of thalamus and hypothalamus. Cerebral cortex: histological structure and localization of functions. CSF: composition, formation, circulation and functions. A brief description of the organization of the autonomic (sympathetic and parasympathetic) nervous system. Functions of sympathetic and parasympathetic nervous system. A brief idea of speech, aphasia, conditioning, learning and memory.

Endocrinology

Hormones - classification. Elementary idea of mechanism of hormone action. Hypothalamus: Basic concept of neurohormone. Hypothalamo-hypophyseal tract and portal system. Pituitary: Histological structure, hormones, functions. Hypo and hyper active states of pituitary gland. Thyroid: Histological structure. Functions of thyroid hormones (T4,T3). Thyrocalcitonin. Hypo and hyper-active states of thyroid. Parathyroid: Histological structure, functions of parathyroid hormone. Tetany. Adrenal Cortex: Histological structure and functions of different hormones. Hypo and hyper-active states of adrenal cortex. Adrenal Medulla: Histological structure and functions of medullary hormones. The relation of adrenal medulla with the sympathetic nervous system. Pancreas: Histology of islets of Langerhans. Origin and functions of pancreatic hormones. Diabetes mellitus. Brief idea of the origin and functions of renin-angiotensin, prostaglandins. erythropoietin and melatonin. Elementary idea of gastrointestinal hormone.

Reproductive Physiology Primary and accessory sex organs and secondary sex characters. Testis: histology, spermatogenesis, testicular hormones and their functions. Ovary: histology, oogenesis, ovarian hormones and their functions. Menstrual cycle and its hormonal control. Maintenance of pregnancy – role of hormones. Development of mammary gland and lactation - role of hormones.

Excretory Physiology Structure and function relationship of kidney. Mechanism of formation of urine. Normal and abnormal constituents of urine. Physiology of micturition. Renal regulation of acid-base balance. Non-excretory functions of kidney. Structure and functions of

skin. Insensible and sensible perspiration Regulation of body temperature -- physical and physiological processes involved in it. Physiology of sweat secretion and its regulation.

GE-2P:

Silver Nitrate preparation of nodes of Ranvier.

Silver nitrate preparation of corneal cell space.

Examination and staining of skeletal and cardiac muscles by Methylene Blue stain

Study and Identification of Stained Sections of Different Mammalian Tissues and Organs: Esophagus, Stomach, Small Intestine, Large Intestine, Liver, Lung, Trachea, Spinal cord, Cerebral cortex, Cerebellum, Thyroid Gland, Adrenal Gland, Pancreas, Spleen, Testes, Ovary, Kidney, Artery and Vein.

Identification of Normal constituents of urine: Chloride, Sulphate, Phosphate, Creatinine and Urea; Abnormal constituents of urine: Glucose, Protein, Acetone, Bile pigment and Bile Salt.

Course outcome: Distinguish between different types of neurons and muscles and how these different features are important for their respective functions. Learn coordination between functions of the neuron and muscle. Learn role of different cations and anions in generation of nerve impulse and its conduction throughout body. Understand the generation of electrical, chemical and mechanical impulse and how these are most important for a living system. Gain knowledge about endocrine system and renal system.

Practical and Demonstration classes provide a careerist approach for the students. i) Students will be able to identify and distinguish between different epithelial cells in normal human body. ii) They will be able to identify some known and unknown bio-molecules which are most important in a living cell. iii) they will be able to measure percentage and total quantity of some specific biomolecules by titration method.

Semester – III

CC5T: Cardiovascular System

Cardiovascular System Anatomy of the heart. Properties of cardiac muscle. Origin and propagation of cardiac impulse. Heart Block. Cardiac cycle: Pressure and volume changes. Heart sounds. Murmurs. Cardiac output: Measurement by application of Fick's principle & factors affecting. Starling's law of heart. Electrocardiography: Electrocardiographic leads, The normal electrocardiogram, Cardiac Arrhythmias &. Myocardial Infarctions. The pulse: Arterial and venous. Hemodynamics of blood flow. Cardiac and vasomotor centers, baroreceptors and chemoreceptors, innervation of the heart and blood vessels, cardiac and vasomotor reflexes. Cardiovascular homeostasis – neural and chemical control of cardiac functions and blood vessels. Atherosclerosis. Coronary Circulation. Blood pressure: Its measurement and factors affecting. Cardiovascular adjustment after hemorrhage.

CC5P: Determination of Blood pressure by Auscultatory Method. Determination of mean pressure, pulse pressure and pulse rate. Preparation of Amphibian Ringer Solution. Kymographic recording of normal and perfused heart of toad and the effects of acetylcholine and adrenaline on the contraction of heart. Recording of ECG.

CC6T: Respiratory System.

Anatomy and histology of the lung and airways. Mechanics of breathing: Role of respiratory muscles, glottis. Compliance of lungs and chest wall, pressure-volume relationships, alveolar surface tension and surfactant, work of breathing. Spirometry: Lung volumes and capacities. Dead space. Pulmonary Circulation: Ventilation- perfusion ratio. Transport of gases (O_2 and CO_2) in body: Partial pressure and composition of normal atmospheric gases in inspired, expired, alveolar airs and blood. Oxygen dissociation curve of hemoglobin and myoglobin – factors affecting. Carbon dioxide dissociation curve. Regulation of respiration -- neural and chemical, respiratory centers, chemoreceptors, baroreceptors, pulmonary receptors. Disorders of Breathing: Hypoxia: Types& effects. Asphyxia, Voluntary hyperpnoea, Apnoea, Cyanosis, Periodic breathing, Asthma, Emphysema. Non-respiratory functions of lung.

C6P: Pneumographic study, measurement of vital capacity, Lung function Test, Measurement of respiratory rate, Effect of exercise on respiratory rate, Determination of VO_2 max.

CC7T: Alimentary system and Excretory system

Alimentary system: Histology of alimentary canal. Digestive glands – histological structures, secretion, functions, and regulation of salivary glands, pancreas, liver. Deglutition.

Movements of alimentary canal and their regulations. Secretion, functions, and regulation of gastric, and intestinal juices. Enterohepatic circulation. Basic concepts of Peptic Ulcer, Jaundice and Gallstones.

Excretory System: Outline structure of kidney, Histology of nephron. Renal circulation – peculiarities and autoregulation. Formation of urine – glomerular function and tubular functions. Counter-current multiplier and exchanger. Renal regulation of osmolarity and volume of blood fluids. Diabetes insipidus. Formation of hypertonic urine. Renal regulation of acid-base balance. Renal function tests – creatinine, inulin, urea, and PAH clearance tests. Physiology of urinary bladder and micturition. Constituents of urine. Abnormal constituents of urine, and pathophysiological significance. Renal dialysis. Non-excretory functions of kidney. Renin-angiotensin system.

CC7P: Recording of intestinal movements by Dale's apparatus; effect of Ach and adrenaline on intestinal movements.

Determination of free and total acidity of gastric juice. Determination of salivary amylase by iodine method. Determination of abnormal constituents of urine.

Course Outcome: Students will learn about all the structures and functions of heart, cardiac regulatory factors, blood pressure and blood circulation.

Students will learn about all these structures, mechanical and physiological functions of lungs and respiratory air passages and related diseases.

Students will be able to understand- 1. Structure and functions of kidney 2. Excretory and non-excretory functions of kidney 3. Structure and functions of skin 4. how body temperature in maintained in human being.

They will be able to measure blood pressure and interpret low or high B.P. They will be able to measure lung functions in different physiological conditions and interpret normal and abnormal lung conditions.

Paper: Skill Enhancement Course I (SEC):

SEC – A (one course in semester 3)
1. Hematological Techniques OR
2. Clinical biochemistry

SEC A1TH

Hematological Techniques

Blood groups - ABO and Rh. Immunological basis of identification of ABO and Rh blood groups. Biochemical basis of ABO system and Bombay phenotype. Blood transfusion - precaution and hazards. Concept of blood bank. Erythropoietin and thrombopoietin. Fetal hemoglobin. Abnormal hemoglobin - thalassemia and sickle-cell anemia. Definition, determination and significance of TC, DC, ESR, Arneth count, PCV, MCV, MHC, MCHC,

bleeding time, clotting time and prothrombin time. Anemia - types (definition and causes). Leukocytosis, Leucopenia and Leukemia. Purpura. Disorders of coagulation.

SEC A1P

DC of WBC, Estimation of hemoglobin, Blood group determination, Bleeding time and Clotting time.

SEC A2TH

Clinical Biochemistry

Pathophysiological significance of the following blood constituents: glucose, serum protein, albumin, urea, creatinine, uric acid, bilirubin and ketone bodies. Lipid profile in health and diseases. Pathophysiological significance of the following serum enzymes and isozymes: Lactate dehydrogenase, Creatine kinase, Amylase, Acid and Alkaline phosphatases, β-glucuronidase, SGPT and SGOT.

SEC A2P

Determine the abnormal constituents of urine, Estimation of SGOT and SGPT in serum, Estimation of glucose by Folin U method, Estimation of Urea by DAM method.

Course Outcome: This course will definitely enhance the skill of the students in hematological techniques and biochemical tests. They would be able to perform various clinical and laboratory tests on their own.

Generic Elective (GE)

[Interdisciplinary for other departments]

GE-3T (Generic): Cellular Basis of Physiology, Biophysical Principles, Enzymes and Chemistry of Bio-molecules Digestion, Absorption & Metabolism.

Cellular Basis of Physiology

Structure and functions of plasma membrane, nucleus and different cell organelles – Endoplasmic reticulum, Golgi bodies, Mitochondria, Lysosome and Peroxisome.

Biophysical Principles, Enzymes and Chemistry of Bio-molecules

Physiological importance of the following physical processes: Diffusion, Osmosis and Surface tension. pH and Buffers – Significance in human body and maintenance of pH in the blood. Colloids - Classification and physiological importance. Enzymes: Classification, factors affecting enzyme action. Concept of coenzymes and isozymes.

Carbohydrates: Definition and classification. Monosaccharides – Classification, structure, physiological importance. Disaccharides – Maltose, Lactose and Sucrose: Structure, occurrence and physiological importance. Polysaccharides – Starch, Glycogen, Dextrin, Cellulose. Lipids:

Definition and classification. Fatty acids Classification. — Definition and importance of, Saponification number and, Iodine number. Phospholipids, Cholesterol & its ester -- physiological importance. Amino acids, Peptides and Proteins: Classification and structure. Structure of peptide bonds. Nucleic acids: Structure of DNA and RNA.

Digestion & Metabolism

Structure in relation to functions of alimentary canal and digestive glands. Composition, functions and regulation of secretion of digestive juices including bile. Digestion and absorption of carbohydrate, protein and lipid. Movements of the stomach and small intestine. 4 Glycolysis, TCA cycle, Importance of Glycogenesis, Glycogenolysis and. Gluconeogenesis. Beta oxidation of saturated fatty acid. Importance of Ketone bodies. Deamination & Transamination. Formation of urea.

Blood and Body Fluids Blood:

Composition and functions. Plasma proteins: origin and functions. Blood cells-- their morphology and functions. Erythropoiesis. Hemoglobin: different types of compounds and derivatives. Coagulation of blood: mechanism, procoagulants, anticoagulants. Lymph and tissue fluids: composition, formation, and functions.

Cardiovascular System

Anatomy and histology of the heart. Properties of cardiac muscle. Origin and propagation of cardiac impulse. Cardiac cycle: Events. Heart sounds. Heart rate. Cardiac output: Determination by following Fick principle, factors affecting. Pulse - arterial and venous. Blood pressure and factors controlling. Baro- and chemoreceptors. Vasomotor reflexes. Peculiarities of regional circulations: coronary and cerebral.

Respiratory System

Anatomy and histology of the respiratory passage and organs. Role of respiratory muscles in breathing. Lung volumes and capacities. Exchange of respiratory gases between lung and blood and between blood and tissues. Transport of oxygen and carbon dioxide in blood. Regulation of respiration - neural and chemical. Hypoxia.

GE-3P: Examination and staining of fresh tissues: Squamous, Ciliated and Columnar Epithelium by Methylene Blue stain. Qualitative tests for identification of: Glucose, Fructose, Lactose, Sucrose, Starch, Dextrin, Lactic acid, Hydrochloric acid, Albumin, Acetone, Glycerol and Bile Salts. Quantitative estimation of amino nitrogen by Sorensen's formol titration method (percentage to be done).

Preparation and staining of human blood film with Leishman's stain and identification of different types of blood cells. Preparation of hemin crystals. Demonstration- kymographic recording of the unperfused heart of toad and effects of warm and cold saline.

Measurement of systolic and diastolic pressure by sphygmomanometer and determination of

pulse and mean pressure. Measurement of peak expiratory flow rate. Pneumographic recording of normal respiratory movements and effects of hyperventilation and breath-holding.

Course Outcome: i) Students will be able to identify blood cells in normal as well as different diseased and medico-legal conditions. ii) They will be able to understand mechanical changes of heart rhythm in response to temperature. iii) They will be able to measure blood pressure and interpret low or high B.P. iv) They will be able to measure lung functions in different physiological conditions and interpret normal and abnormal lung conditions.

Semester –IV

CC8T: Digestion &Metabolism

Digestion and absorption of protein fat and carbohydrate. Redox potential. Mitochondrial Electron Transport Chain. Oxidative phosphorylation-inhibitors and uncouplers. Carbohydrate: Glycolysis, R-L cycle. TCA cycle, Gluconeogenesis - Cori cycle. Pentose phosphate pathway. Glycogenesis and Glycogenolysis. Lipid: β-oxidation and biosynthesis of saturated and monounsaturated fatty acids. Biosynthesis of lecithin. Biosynthesis of Cholesterol. Ketone body metabolism. [Hormonal regulation of the above-mentioned biochemical pathways not required]. Amino acids: Amino acids - Amino acid pool. Glucogenic and ketogenic amino acids. Deamination, transamination, amination and decarboxylation. Synthesis of Urea and Nitric oxide. Biosynthesis of physiologically important compounds (catecholamines, serotonin, melatonin, GABA, glutathione). Purines and Pyrimidines– Biosynthesis: de novo and salvage pathways. Catabolism.

CC8P: Biochemical estimation by Colorimetric Method, Serum protein by (biuret method), Serum albumin, Blood glucose by Nerlson –Samogyi Method, Serum urea by DAM Method, inorganic phosphate by Fick Subaro method

CC9T: Nutrition & Dietetics

Nutrition and dietetics Vitamins: Thiamin, Riboflavin, Niacin, Pyridoxine, Pantothenic Acid, Biotin, Cyanocobalamin, Folic Acid, Ascorbic Acid, Inositol. Vitamins A, D, E and K. Dietary sources, daily requirements, biochemical functions, deficiency symptoms, hypervitaminosis, antivitamins. Minerals: Sources, biological functions of sodium, potassium, calcium, phosphorus, iron, zinc, iodine and selenium's, RQ and BMR: Factors affecting. Determination of BMR. Dietary requirements of carbohydrate, protein, lipid and other nutrients. Balanced diet and principles of formulation of balanced diets for adult man, adult woman, lactating woman and pregnant women. Nitrogen balance. Protein spares. Supplementary value of proteins. Biological value of proteins.Net protein utilization. Protein efficiency ratio. Dietary fibers.

CC9P: Diet survey report of a family as per ICMR specification.

Qualitative analysis of milk, potato, flour, rice, pulses.

CC10T:-Nervous System

The Nervous System Structural organization of different parts of brain and spinal cord. Reflex¬ action – definition, reflex arc, classification and properties. Autonomic nervous system: organization, outflow, ganglia, centers and¬ functions. Chemical transmission in autonomic nervous systems. CSF: Formation, circulation and functions. Blood-Brain barrier. Ascending and descending tracts (tract of Goll, Burdach, Flechsig, Gowrt Spinocortical, Pyramidal, RubroSpinal, Tectospinal, Reticulospinal): origin, courses, termination and functions. Functions of the spinal cord with special reference to functional changes following hemi section and complete section of spinal cord. Pain production, perception and regulation. Referred pain. Muscle spindle and Golgi tendon organ: their structure, innervations and functions, postural reflexes. Decorticate, decerebrate rigidity and spinal animal. Brain: Structure, nerve connections and functions of brainstem, cerebellum,¬ reticular formation, hypothalamus, thalamus, basal nuclei and cerebral cortex- Speech and aphasia. Structure and functions of vestibular apparatus. Limbic system: Structure, connections and functions. Physiology of sleep and EEG. Learning, memory, and emotion. Cerebral circulation & stroke.

CC10: Experiment on Superficial (Plantar) & deep (kneejerk) reflex, reaction time by stick drop test, short term memory (shape pic word), two-point discrimination test. Postural effect on HR, BP.

H-E staining of spinal cord, cerebellum and cerebral cortex.

Course outcome: Students will be able to understand and interpret all these procedures and also understand the structures and functions of the digestive organs and their specific functions related to different types of foods. They will be able to know the functions and classify different digestive enzymes They will be able to differentiate between extra- and intra-cellular enzymes They would gather knowledge about most important process involved in energy production. Understand energy metabolism.

Students will:

1. Understand the complicated structure of the nervous system, its organizations and functions
2. Be able to distinguish between sensory and motor signals, their coordination through reflex actions and also learn about the neuronal pathways/tracts carrying these signals throughout our body.
3. The structure and functions of the brain and spinal cord. And their functions regarding conditioned and unconditioned reflex.
4. Understand the functions of different brain areas regarding Learning, Memory, Emotions, Intelligence, Motor control, Thinking, Sleep, Body temperature maintenance, Body balance and

Kinesthetic coordination and many more.

Paper: Skill Enhancement Course I (SEC):

SEC –B (one course in semester 4)

1. Applied food sciences
2. Fundamentals of computer and Bioinformatics

SEC B1TH

Detection of Food Additives / Adulterants & Xenobiotics

Definition of food adulterants/ additive. Tests for identifying food adulterants-- Metanil yellow, Rhodamine B, Saccharin, Monosodium glutamate, Aluminum foil, Dioxin, Chicory and Bisphenol. Concept of Xenobiotics- Types, sources and fate. Types of reactions in detoxification and their mechanisms- oxidation, reduction, hydrolysis and conjugation.

SEC B2TH

Fundamentals of computer and Bioinformatics

Computer: Basic concepts of software and hardware, types of computers, elementary idea of computer

Internet: Webpages, Internet protocols, Search engines, Subject Directories etc. Biological Database management systems: a. Nucleic acid sequences databases b. Genome databases (e.g., Human Genome Project) c. Protein sequence and structure databases d. Literature databases 4. **Importance of Bioinformatics.**

Introduction to Data archiving systems (FASTA format, Accession number)

Applications of bioinformatics: a. Data retrieval systems: data query and data mining (Pubmed, Entrez), Sequence retrieval system (SRS) and protein identification resource (PIR). b. Molecular sequence analysis software packages and tools, Sequence alignments (Pairwise & multiple alignment) c. Molecule structure: domains, folds and motif analysis. d. Evolutionary study with Phylogenetic trees.

Course Outcome: The student would learn about various food adulterants and they would be able to apply this knowledge in real life. They would also get a brief knowledge on bioinformatics. This allied paper introduces the students to concepts in bioinformatics. The student will be able to apply basic principles of biology, computer science and mathematics to address complex biological problems

Generic Elective (GE)

[Interdisciplinary for other departments]

GE-4T: Nerve-muscle Physiology Nervous System, Endocrinology Reproductive Function

Excretory Physiology

Nerve-muscle Physiology Nervous System

Nerve-muscle Physiology Structure of neurons. Origin and propagation of nerve impulse. Velocity of impulse in different types of nerve fiber. Properties of nerve fibers: all or none law, rheobase and chronaxie, refractory period. indefatigability. Synapses: structure, mechanism of synaptic transmission. Motor unit. Myoneural junction: structure, mechanism of impulse transmission. Degeneration and regeneration in nerve fibers.

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. Properties of muscle: all or none law, beneficial effect, summation, refractory period, tetanus, fatigue.

Nervous System A brief outline of organization and basic functions (sensory, motor and association) of the nervous system, central and peripheral nervous system. Ascending tracts carrying touch, kinesthetic, temperature and pain sensations. Descending tracts: pyramidal tract and brief outline of the extra-pyramidal tracts. Reflex action - definition, reflex arc, classification, properties. Functions of the spinal cord. Outline of functions of brain stem. A brief idea of the structure, connections and functions of cerebellum. Different nuclei and functions of thalamus and hypothalamus. Cerebral cortex: histological structure and localization of functions. CSF: composition, formation, circulation and functions. A brief description of the organization of the autonomic (sympathetic and parasympathetic) nervous system. Functions of sympathetic and parasympathetic nervous system. A brief idea of speech, aphasia, conditioning, learning and memory.

Endocrinology

Hormones - classification. Elementary idea of mechanism of hormone action. Hypothalamus: Basic concept of neurohormone. Hypothalamo-hypophyseal tract and portal system. Pituitary: Histological structure, hormones, functions. Hypo and hyper active states of pituitary gland. Thyroid: Histological structure. Functions of thyroid hormones (T4,T3). Thyrocalcitonin. Hypo and hyper-active states of thyroid. Parathyroid: Histological structure, functions of parathyroid hormone. Tetany. Adrenal Cortex: Histological structure and functions of different hormones. Hypo and hyper-active states of adrenal cortex. Adrenal Medulla: Histological structure and functions of medullary hormones. The relation of adrenal medulla with the sympathetic nervous system. Pancreas: Histology of islets of Langerhans. Origin and functions of pancreatic hormones. Diabetes mellitus. Brief idea of the origin and functions of renin-angiotensin, prostaglandins. erythropoietin and melatonin. Elementary idea of gastrointestinal hormone.

Reproductive Physiology Primary and accessory sex organs and secondary sex characters. Testis: histology, spermatogenesis, testicular hormones and their functions. Ovary: histology, oogenesis, ovarian hormones and their functions. Menstrual cycle and its hormonal control.

Maintenance of pregnancy – role of hormones. Development of mammary gland and lactation - role of hormones.

Excretory Physiology Structure and function relationship of kidney. Mechanism of formation of urine. Normal and abnormal constituents of urine. Physiology of micturition. Renal regulation of acid-base balance. Non-excretory functions of kidney. Structure and functions of skin. Insensible and sensible perspiration Regulation of body temperature -- physical and physiological processes involved in it. Physiology of sweat secretion and its regulation.

GE-4P:

Silver Nitrate preparation of nodes of Ranvier.

Silver nitrate preparation of corneal cell space.

Examination and staining of skeletal and cardiac muscles by Methylene Blue stain

Study and Identification of Stained Sections of Different Mammalian Tissues and Organs: Esophagus, Stomach, Small Intestine, Large Intestine, Liver, Lung, Trachea, Spinal cord, Cerebral cortex, Cerebellum, Thyroid Gland, Adrenal Gland, Pancreas, Spleen, Testes, Ovary, Kidney, Artery and Vein.

Identification of Normal constituents of urine: Chloride, Sulphate, Phosphate, Creatinine and Urea; Abnormal constituents of urine: Glucose, Protein, Acetone, Bile pigment and Bile Salt.

Course outcome: Gaining knowledge on various systems of physiology. Practical and Demonstration classes provide a careerist approach for the students. i) Students will be able to identify and distinguish between different epithelial cells in normal human body. ii) They will be able to identify some known and unknown bio-molecules which are most important in a living cell. iii) they will be able to measure percentage and total quantity of some specific biomolecules by titration method.

Semester –V

CC11T: Special senses and body temperature regulation.

Special Senses Characteristics of special senses, Weber-Fechner law, Vision: Structure of eyeball. Histology of retina. Visual pathway and centers. Effects of lesion in visual pathway. Mechanism of accommodation. Errors of refraction and their corrections. Cataract and Glaucoma. Photopic and scotopic vision. Chemical and electrical changes in retina on exposure to light. Positive and negative after- images. Light and dark adaptation. Colour vision—Trichromatic, Single and Double Opponent mechanism. Colour blindness. Visual field-- perimetry. Visual acuity Critical fusion frequency. Hearing: Structure and functional significance of auditory apparatus. Organ of Corti. Auditory pathways and centers. Mechanism of hearing – Excitation of Hair Cells, Conversion of Sound Waves into Action Potentials in the Auditory Nerve. Mechanism of discrimination of sound frequencies and intensities. Localization of sound source. Deafness. Olfaction and Gustation: Structure and functions of the receptor organs, nerve pathways, Centers. Signal Transduction of olfactory and gustatory stimuli. Abnormalities of olfactory and taste

Skin and Body Temperature Regulation: Structure and functions of skin. Cutaneous circulation. Sweat glands –structure and composition of sweat. Mechanism of sweat formation, secretion and its regulation. Insensible perspiration. Regulation of body temperature in human. Pyrexia, hyperthermia and hypothermia.

CC11P: Determination of visual acuity by Snellen's Chart, Determination of Colour Blindness by Ishihara Char, perimetry. Determination of Deafness by Tuning Fork Test, Determination of hearing threshold by audio meter. Silver Nitrate Preperation of Corneal Cell Space.

CC12T Genetics, Molecular Biology and Biotechnology.

Genetics Chromosome Structure-- Morphology. Chromosomal DNA packaging-nucleosomes and higher level of organisation of chromatin. Euchromatin and heterochromatin..Human genome and its characteristics. Mitochondrial DNA. Karyotyping. Cell cycle – Events and regulation (Brief). Cell division- Brief idea on Mitosis & Meiosisphases and significance. Crossing-over, Linkage.

Molecular Biology: DNA replication—Meselson and Stahl Experiment, DNA Polymerases, Ligases and¬ other proteins and mechanism of regulation (prokaryoyes). Transcription -- RNA Polymerase and its functions in prokaryotes. Genetic code – properties and wobble hypothesis. Translation – codon-anticodon interaction and

mechanism in prokaryotes. Regulation of gene expression: operon concept – the lac operon. Gene mutation – agents and types. DNA repairing processes. Concept of oncogenes and properties of cancer cells (Brief). Recombinant DNA technology in brief and its applications – gene therapy, transgenic animal.

CC12P: Identification of metaphasic chromosome. Estimation of protein by Lowry method, DNA by DPA method, RNA by orcinol method. Identification of DNA on agarose gel, Isolation of plasmid.

Course Outcome: Students will

1. Understand structure and specific functions of these special organs.
2. Be able to distinguish between different neuronal organizations involved in different special sensory mechanism.
3. Understand mechanism of special sensory adaptations.
4. Have elementary idea about vision, light and darkness and mechanism of image formation through eye.
5. They would learn about the molecular basis of inheritance and genetics.

DISCIPLINE SPECIFIC ELECTIVE (DSE)

DSE-A: (one course in semester 5 & one course in semester 6)

1. Biostatistics & computational biology
2. Microbiology & Immunology
3. Advanced Molecular biology & Nanotechnology
4. Community and social medicine,

DSE – B: (one course in semester 5 & one course in semester 6)

1. Application of instruments in study of physiology
2. Work and sport physiology and Ergonomics
3. Toxicology &Pharmacology
4. Stress Physiology, Yoga and meditation.

DSE: GROUP-A

Bio-Statistics & Computational Biology

DSE A1TH

Basic concepts– Variable, population, parameter, sample, statistic. Classification of data –

qualitative and quantitative, continuous and discontinuous. Presentation of data–frequency distribution, bar diagram, pie diagram, frequency polygon and histogram. Mean, median, mode, standard deviation and standard error of ungrouped data. Concept of probability, Null and Alternate Hypotheses, Characteristics and uses of Normal and t-distributions.

DSE A1P

Computation of mean, median, mode, standard deviation and standard error of the mean using physiological data like body temperature, pulse rate, respiratory rate, height and weight of human subjects. Graphical representation of data in bar diagram, pie diagram frequency polygon and histogram.

Course Outcome: This course imparts the knowledge of basic statistical methods to solve problems. Students are taught to operate various statistical software packages. By the end of the course, the students are able to appreciate the importance of statistics in research and prepares them for a career in research

Microbiology & Immunology

DSE A2 TH

Viruses - DNA virus and RNA virus. Viroids and Prions. Bacteriophages. Bacteria-structure and morphological classification. Gram positive and Gram negative and acid-fast bacteria. Pathogenic and non-pathogenic bacteria - definition with a few examples. Physical and chemical methods used in disinfection, sterilization and pasteurization. Nutritional requirement – complex and synthetic media, preparation of media; physical factors required for growth (temperature, pH and gaseous requirement). Bacterial growth curve. Elementary idea of bacteriostatic and bactericidal agents.

Beneficial and harmful microorganisms in food. Elementary knowledge of innate and acquired immunity. Humoral and cell mediated immunity. Toxins and toxoids. Vaccination – Passive and active immunization, types and uses of vaccine. Immunological basis of allergy and inflammation.

DSE A2P

Sterilization, Negative Staining, Gram Staining, Acid-fast Staining, Bacterial Spore Staining, Culture preparation, Isolation of Bacteria.

Course Outcome: This fundamental paper discusses the importance of microorganisms. The course throws light on types of microorganisms in and around humans. At the end of the course, the student has understanding on the metabolism and mechanism of microbial life. This course gives an overview on the immune system including organs, cells and receptors. The students learn about molecular basis of antigen recognition, hypersensitivity reaction, antigen-antibody reactions. The course develops in the student an appreciation for principles of immunology and its applications in treating human diseases.

Application of instruments in study of physiology

DSE B1TH

Principles uses, advantages and disadvantages: Compound microscope, Phase contrast microscope, Fluorescence microscope, Confocal microscopy, Transmission and Scanning electron microscope. Spectrophotometer and pH meter.

Chromatography: Principles and uses of : TLC, Gel filtration, Affinity chromatography, ion-exchange chromatography. Electrophoresis: Principles and method, uses of Agarose gel electrophoresis, SDS – PAGE. Centrifugation: Density gradient ultracentrifugation. Radioactivity – Radiolabeling of biomolecules and its detection by autoradiography. Principles of RIA, ELISA. Western, Northern and Southern blotting techniques. Polymerase chain reaction-basic concept. Principles and uses of CT scan, MRI and PETscan.

DSE B1P

Single staining, negative staining, Ion exchange and gel filtration chromatography, TLC, SDS-PAGE.

Course Outcome: This course will teach the students the various instrumentations that are used in the analytical laboratories. This course covers both fundamental and applications of the instruments that are routinely used for the characterization of biomolecules. At the end of the course, the student has the basic knowledge on the theory, operation and function of analytical instruments.

Work & Sports Physiology and Ergonomics

DSE B2TH

Concept of physical work and physiological work. Classification of work loads. Energetics of muscular work. Measurement of energy cost. Cardiovascular and respiratory responses to graded exercise.Maximal oxygen consumption and post-exercise oxygen consumption – definition, factors affecting, measurement and significance. Muscle fatigue and recovery. Physical fitness and its assessment by modified Harvard Step Test. Ergonomics. Importance of ergonomics in occupational health and well being. Definition of anthropometry. Different body dimensions measured in anthropometry and their significance.

DSE B2P

Measurement of resting and working heart rate using thirty beats and ten beats methods respectively. Measurement of blood pressure before and after exercise. Determination of Physical Fitness Index by modified Harvard Step Test. Measurement of some common anthropometric parameters- stature, weight, eye height (standing), shoulder height, sitting height, knee height (sitting), arm reach from wall, mid-arm circumference, waist circumference, hip circumference, neck circumference, head circumference, chest circumference. Calculation

of BSA and BMI from anthropometric data.

Course outcome: Upon successful completion of this course students will be able to identify ergonomic risks in their workplace, analyze ergonomic risk assessment results, compare them in dynamics, compare identified problems in India and worldwide, analyze the impact of ergonomic risks on work and quality of life. Students will be able to independently identify and evaluate ergonomic risks, their impact on humans, evaluate the results obtained and interpret the reliability of the data. Students will be able to evaluate the ergonomics and suitability of different sports equipment and equipment, choosing the best.

Advanced Molecular biology & Nanotechnology

DSE A3TH

Elementary idea of Genetic Engineering, Molecular Cloning and its significance, Isolation of DNA fragment to be cloned, Restriction Enzymes, Vectors, Ligation of insert and Vector, Introduction of recombinant DNA into host cell, Screening for Recombinant DNA. Idea about Human Genome Project.

Principles of Nanotechnology, Properties and Characterization of Nanoparticles, Application of nanotechnology in drug delivery.

DSE A3P

Isolation of Genomic DNA, Isolation of Plasmid DNA, DNA gel electrophoresis. Quantification of DNA by DPA Method, Quantification of RNA by Orcinol Method, Quantification of Protein by Bradford Reagent.

Course Outcome: This is an interdisciplinary and emerging area. The students are taught the basics of nanotechnology and their applications. The course introduces the students to the new and novel applications to solve biomedical problems through nanotechnology. It deals with understanding the molecular aspects of the biology. It majorly emphasizes the concepts of central dogma of molecular biology spanning from DNA Replication till Protein Synthesis and Reverse transcription. It also helps in understanding the concepts of cellular function.

Toxicology &Pharmacology

DSE B3TH

The importance of pharmacology in the study of physiological processes- drugs, agonist, antagonist.

Pharmacokinetics-absorption, distribution, excretion and bioavailability of drugs. Drug biotransformation. The dose effect relationship and the characteristics of dose response curve. Assessment of drug toxicity- LD50nand ED50. Drugs affectin synaptic and neuroeffector functional sites-chemistry, organ system effects and mechanism of action of phenoxybenzamine, phentolamine, propranolol and nodolol. Drugs affecting catecholamine and

cholinergic neuro transmission-guanithidine, reserpine, physostigmine and nerve gases (tabun, sarin). Neuromuscular blocking agents, tubocurarine, succinyl choline, nicotine. Sedative-hypnotics. Barbiturates- actions on organ systems and mechanism of action. Antihistamines: Pharmacological properties.

Diuretics: Effects on renal functions and mechanism of action of benzothiadiazides.

Course Outcome: At the end of the teaching, the student must demonstrate to have adequate knowledge of the pharmacology and pharmacotherapy of the disorders treated, as well as the toxicological aspects related to the use of xenobiotics. The student must also demonstrate the ability to apply basic knowledge in the management of pharmacological and toxicological problems.

Community and Social Medicine

DSE A4 TH

Basic idea about community, public health issues. Malnutrition in a community, over nutrition and possible remedial measures. Diet management of obese, diabetic. 12 Basic idea of PCM and their prevention. PCM -- Marasmus, kwashiorkor. Endemic goiter, rickets, osteomalacia, xeropthalmia, beriberi and their social implications. Etiology, epidemiology and prevention of: Communicable diseases : Malaria, Dengue, Hepatitis and AIDS; Non-communicable diseases – Hypertension and Obesity. Population problem – principles and methods of family planning, and Assisted Reproductive Technologies. Principles of diet survey. Composition and nutritional value of common food stuffs. Principles of formulation of diet chart of growing children, pregnant & lactating women and diabetic patients.

DSE A4P:

Diet survey report (hand-written) of a family (as per ICMR specification): Each student has to submit a report on his/her own family.

Course Outcome: Collect, analyse, interpret and present simple community and hospital based data, family and community levels keeping in mind the existing health care resources and in the context of the prevailing socio-cultural beliefs. Diagnose and manage maternal and child health problems and advise a couple and the community on the family welfare planning methods available in the context of the national priorities. Also, to manage all other patients reporting at primary level as per the standard treatment guidelines and the health resources available. Diagnose and manage common nutritional problems at the individual and community level. Plan, implement and evaluate a health education programme with skill to use simple audio-visual aids. Interact with, other members of the health care team and participate in the organization of health care services and implementation of national health programmes.

Stress Physiology, Yoga and meditation.

DSE B4TH

Exercise in cold-physiological responses to exercise in cold, health risks during exercise in cold, effect of cold in human performance, exercise in hot environment, physiological responses to exercise in heat. Exercise in high altitude physiological adaptation at altitude, aerobic performance at high altitude, training for competition at high altitude. Exercise for the disabled physically and mentally challenged. Yogic exercise & Fitness: physiology of yogic exercise, therapeutic use of yoga.

Yoga, meditation & relaxation, sports & mechanics, sports & socialization, yoga & stress management.

Course Outcome: This course focuses upon a global, interdisciplinary, cross-cultural and contextual view on stress and coping. Our collective inquiry will afford students the opportunity to apply thinking across a variety of professional roles in psychology, health care, social work, education and leadership.

Semester-VI

CC13T: Endocrinology and Chronobiology

Endocrinology Hypothalamus as a neuroendocrine organ. Anterior and posterior pituitary -- histological structure of the gland. Chemical nature, mechanism of action, functions and regulation of secretion of GH, ADH, oxytocin. Pineal hormone (melatonin). Thyroid and Parathyroid -- Histological structure of the glands. Chemical nature, mechanism of action, functions and regulation of secretion of the hormones. Adrenal cortex and medulla -- Histological structure of the gland. Chemical nature, mechanism of action, functions and regulation of secretion of the hormones. Heart as an endocrine organ. Pancreatic islets -- Histological structure. Chemical nature, mechanism of action, functions and regulation of secretion of the hormones. Hormonal control of blood sugar. Hyperinsulinism and diabetes mellitus. Gastro-intestinal hormones -- Chemical nature, mechanism of action and functions. Hypo and hyper secretion of hormone and hormonal disorder.

CC13P: Identification of lung, Kidney, Skin, Testis, Ovary, Thyroid, Pancreas, Spleen, Lymph gland, salivary gland, stomach, intestine, Liver Adrenal gland, pituitary.

Report on Educational Excursion.

CC14T: Reproductive Physiology & Developmental Biology

Reproductive Physiology Primary and accessory sex organs and secondary sex characters. Histology of testis. Endocrine functions of testis. Spermatogenesis. Hypothalamic control of testicular functions. Histology of ovary. Ovarian hormones and their functions. Oogenesis and ovulation. Formation and functions of corpus luteum. Hypothalamic control of ovarian functions. Physiology of puberty. Menstrual cycle and its regulation. Abnormalities in menstrual cycle. Onset of menopause and postmenopausal changes. Structure and functions of placenta. Maintenance of pregnancy and the bodily changes during pregnancy. Parturition. Pregnancy tests.

Development of mammary glands, lactation and their hormonal control. Developmental Biology Stem cell: Characteristics and applications. Totipotency, Differentiation. Ultra structure: Sperm and Ovum. Fertilization, Blastulation, Implantation, Gastrulation. Organogenesis: Development of Heart, urinary system and genital system. Fetal Circulation.

CC14P: Pregnancy Test, sperm count, Study of estrus cycle. Determination serum calcium, measurement of activity of acid phosphatase (total and prostatic) from serum.

Course Outcome: Students will be able to understand

1. location, basic anatomy and functions of endocrine glands in human body
2. Functions and Classification of hormones
3. Molecular mechanism of hormone actions
4. Hormone-related diseases
5. Have a basic idea about sex organs, their anatomy, molecular structure in male and female human beings
6. learn about gametogenesis and their hormonal control
7. be able to understand the complex mechanism of pregnancy and lactation.

DISCIPLINE SPECIFIC ELECTIVE (DSE)

DSE-A: (one course in semester 5 & one course in semester 6)
1. Biostatistics & computational biology

2. Microbiology & Immunology

3. Advanced Molecular biology & Nanotechnology

4. Community and social medicine,

DSE – B: (one course in semester 5 & one course in semester 6)

3. Application of instruments in study of physiology

4. Work and sport physiology and Ergonomics

3. Toxicology &Pharmacology

4. Stress Physiology, Yoga and meditation.

DSE: GROUP-A

Bio-Statistics & Computational Biology

DSE A1TH

Basic concepts– Variable, population, parameter, sample, statistic. Classification of data – qualitative and quantitative, continuous and discontinuous. Presentation of data–frequency distribution, bar diagram, pie diagram, frequency polygon and histogram. Mean, median, mode, standard deviation and standard error of ungrouped data. Concept of probability, Null and Alternate Hypotheses, Characteristics and uses of Normal and t-distributions.

DSE A1P

Computation of mean, median, mode, standard deviation and standard error of the mean using physiological data like body temperature, pulse rate, respiratory rate, height and weight of human subjects. Graphical representation of data in bar diagram, pie diagram frequency polygon and histogram.

Course Outcome: This course imparts the knowledge of basic statistical methods to solve problems. Students are taught to operate various statistical software packages. By the end of the course, the students are able to appreciate the importance of statistics in research and prepares them for a career in research

Microbiology & Immunology

DSE A2 TH

Viruses - DNA virus and RNA virus. Viroids and Prions. Bacteriophages. Bacteria-structure and morphological classification. Gram positive and Gram negative and acid-fast bacteria. Pathogenic and non-pathogenic bacteria - definition with a few examples. Physical and chemical methods used in disinfection, sterilization and pasteurization. Nutritional requirement – complex and synthetic media, preparation of media; physical factors required for growth (temperature, pH and gaseous requirement). Bacterial growth curve. Elementary idea of bacteriostatic and bactericidal agents.

Beneficial and harmful microorganisms in food. Elementary knowledge of innate and acquired immunity. Humoral and cell mediated immunity. Toxins and toxoids. Vaccination – Passive and active immunization, types and uses of vaccine. Immunological basis of allergy and inflammation.

DSE A2P

Sterilization, Negative Staining, Gram Staining, Acid-fast Staining, Bacterial Spore Staining, Culture preparation, Isolation of Bacteria.

Course Outcome: This fundamental paper discusses the importance of microorganisms. The course throws light on types of microorganisms in and around humans. At the end of the course, the student has understanding on the metabolism and mechanism of microbial life. This course gives an overview on the immune system including organs, cells and receptors. The students learn about molecular basis of antigen recognition, hypersensitivity reaction, antigen-antibody reactions. The course develops in the student an appreciation for principles of immunology and its applications in treating human diseases.

Application of instruments in study of physiology

DSE B1TH

Principles uses, advantages and disadvantages: Compound microscope, Phase contrast microscope, Fluorescence microscope, Confocal microscopy, Transmission and Scanning electron microscope. Spectrophotometer and pH meter.

Chromatography: Principles and uses of : TLC, Gel filtration, Affinity chromatography, ion-exchange chromatography. Electrophoresis: Principles and method, uses of Agarose gel electrophoresis, SDS – PAGE. Centrifugation: Density gradient ultracentrifugation. Radioactivity – Radiolabeling of biomolecules and its detection by autoradiography. Principles of RIA, ELISA. Western, Northern and Southern blotting techniques. Polymerase chain reaction-basic concept. Principles and uses of CT scan, MRI and PETscan.

DSE B1P

Single staining, negative staining, Ion exchange and gel filtration chromatography, TLC, SDS-PAGE.

Course Outcome: This course will teach the students the various instrumentations that are used in the analytical laboratories. This course covers both fundamental and applications of the instruments that are routinely used for the characterization of biomolecules. At the end of the course, the student has the basic knowledge on the theory, operation and function of analytical instruments.

Work & Sports Physiology and Ergonomics

DSE B2TH

Concept of physical work and physiological work. Classification of work loads. Energetics of muscular work. Measurement of energy cost. Cardiovascular and respiratory responses to graded exercise.Maximal oxygen consumption and post-exercise oxygen consumption – definition, factors affecting, measurement and significance. Muscle fatigue and recovery. Physical fitness and its assessment by modified Harvard Step Test. Ergonomics. Importance of ergonomics in occupational health and well being. Definition of anthropometry. Different body dimensions measured in anthropometry and their significance.

DSE B2P

Measurement of resting and working heart rate using thirty beats and ten beats methods respectively. Measurement of blood pressure before and after exercise. Determination of Physical Fitness Index by modified Harvard Step Test. Measurement of some common anthropometric parameters- stature, weight, eye height (standing), shoulder height, sitting height, knee height (sitting), arm reach from wall, mid-arm circumference, waist circumference, hip circumference, neck circumference, head circumference, chest circumference. Calculation of BSA and BMI from anthropometric data.

Course outcome: Upon successful completion of this course students will be able to identify ergonomic risks in their workplace, analyze ergonomic risk assessment results, compare them in dynamics, compare identified problems in India and worldwide, analyze the impact of ergonomic risks on work and quality of life. Students will be able to independently identify and evaluate ergonomic risks, their impact on humans, evaluate the results obtained and interpret the reliability of the data. Students will be able to evaluate the ergonomics and suitability of different sports equipment and equipment, choosing the best.

Advanced Molecular biology & Nanotechnology

DSE A3TH

Elementary idea of Genetic Engineering, Molecular Cloning and its significance, Isolation of DNA fragment to be cloned, Restriction Enzymes, Vectors, Ligation of insert and Vector,

Introduction of recombinant DNA into host cell, Screening for Recombinant DNA. Idea about Human Genome Project.

Principles of Nanotechnology, Properties and Characterization of Nanoparticles, Application of nanotechnology in drug delivery.

DSE A3P

Isolation of Genomic DNA, Isolation of Plasmid DNA, DNA gel electrophoresis. Quantification of DNA by DPA Method, Quantification of RNA by Orcinol Method, Quantification of Protein by Bradford Reagent.

Course Outcome: This is an interdisciplinary and emerging area. The students are taught the basics of nanotechnology and their applications. The course introduces the students to the new and novel applications to solve biomedical problems through nanotechnology. It deals with understanding the molecular aspects of the biology. It majorly emphasizes the concepts of central dogma of molecular biology spanning from DNA Replication till Protein Synthesis and Reverse transcription. It also helps in understanding the concepts of cellular function.

Toxicology &Pharmacology

DSE B3TH

The importance of pharmacology in the study of physiological processes- drugs, agonist, antagonist.

Pharmacokinetics-absorption, distribution, excretion and bioavailability of drugs. Drug biotransformation. The dose effect relationship and the characteristics of dose response curve. Assessment of drug toxicity- LD50nand ED50. Drugs affectin synaptic and neuroeffector functional sites-chemistry, organ system effects and mechanism of action of phenoxybenzamine, phentolamine, propranolol and nodolol. Drugs affecting catecholamine and cholinergic neuro transmission-guanithidine, reserpine, physostigmine and nerve gases (tabun, sarin). Neuromuscular blocking agents, tubocurarine, succinyl choline, nicotine. Sedative-hypnotics. Barbiturates- actions on organ systems and mechanism of action. Antihistamines: Pharmacological properties.

Diuretics: Effects on renal functions and mechanism of action of benzothiadiazides.

Course Outcome: At the end of the teaching, the student must demonstrate to have adequate knowledge of the pharmacology and pharmacotherapy of the disorders treated, as well as the toxicological aspects related to the use of xenobiotics. The student must also demonstrate the ability to apply basic knowledge in the management of pharmacological and toxicological problems.

Community and Social Medicine

DSE A4 TH

Basic idea about community, public health issues. Malnutrition in a community, over nutrition and possible remedial measures. Diet management of obese, diabetic. 12 Basic idea of PCM and

their prevention. PCM -- Marasmus, kwashiorkor. Endemic goiter, rickets, osteomalacia, xeropthalmia, beriberi and their social implications. Etiology, epidemiology and prevention of: Communicable diseases: Malaria, Dengue, Hepatitis and AIDS; Non-communicable diseases – Hypertension and Obesity. Population problem – principles and methods of family planning, and Assisted Reproductive Technologies. Principles of diet survey. Composition and nutritional value of common food stuffs. Principles of formulation of diet chart of growing children, pregnant & lactating women and diabetic patients.

DSE A4P:

Diet survey report (hand-written) of a family (as per ICMR specification): Each student has to submit a report on his/her own family.

Course Outcome: Collect, analyse, interpret and present simple community and hospital based data, family and community levels keeping in mind the existing health care resources and in the context of the prevailing socio-cultural beliefs. Diagnose and manage maternal and child health problems and advise a couple and the community on the family welfare planning methods available in the context of the national priorities. Also, to manage all other patients reporting at primary level as per the standard treatment guidelines and the health resources available. Diagnose and manage common nutritional problems at the individual and community level. Plan, implement and evaluate a health education programme with skill to use simple audio-visual aids. Interact with, other members of the health care team and participate in the organization of health care services and implementation of national health programmes.

Stress Physiology, Yoga and meditation.

DSE B4TH

Exercise in cold-physiological responses to exercise in cold, health risks during exercise in cold, effect of cold in human performance, exercise in hot environment, physiological responses to exercise in heat. Exercise in high altitude physiological adaptation at altitude, aerobic performance at high altitude, training for competition at high altitude. Exercise for the disabled physically and mentally challenged. Yogic exercise & Fitness: physiology of yogic exercise, therapeutic use of yoga.

Yoga, meditation & relaxation, sports & mechanics, sports & socialization, yoga & stress management.

Course Outcome: This course focuses upon a global, interdisciplinary, cross-cultural and contextual view on stress and coping. Our collective inquiry will afford students the opportunity to apply thinking across a variety of professional roles in psychology, health care, social work, education and leadership.

Suggested Readings:

1. Text book of Medical Physiology, by A.C. Guyton, John E. Hall, Eleventh edition. Elsevier Saunders.

2. Vander et al's Human Physiology: The Mechanisms of Body Function; 9th Edition Eric P. Widmaier, Hershel Raff, Kevin T. Strang The Mc Graw-Hill Companies.

3. Human Physiology, From Cells to Systems Lauralee Sherwood, Brooks/Cole.

4. Best & Taylor's Physiological Basis of Medical Practice, edited by B.R Brobeck. The William and Wilkins Co.

5. Ganong's Review of Medical Physiology, by Kim E. Barrett et al., Lange Medical Book.

6. Harper's Review of Biochemistry by R K. Murry and others. Lange Medical Book, Prentice-Hall International.

7. Lehninger Principles of Biochemistry, by, D. L. Nelson and M. M. Cox, CBS Publishers Inc.

8. Text book of Biochemistry, by E.S. West, W.R. Todd, H.S. Mason, J.T. Van Bruggen, The Macmillan Company.

9. Biochemistry, by D. Das: Academic Publishers.

10. Biophysics and Biophysical Chemistry, by D .Das, Academic Publishers.

11. Samson Wright's Applied Physiology, edited by C.A. Keele. E. Neil & N. Toets. Oxford University Press.

12. Physiology, by R.M. Berne & M.N. Levy, B.M. Koeppen, B. A. Stanton, Mosby Co.

13. Basic Histology, by L.C. Jungquire, J. Carneiro& J.A Long; Appleton & Lange.

14. Neuroscience Third Edition Edited By D. Purves, G. J. Augustine, D. Fitzpatrick, W. C. Hall, A S.I. Lamantia, J.O. Mcnamara, S. M Williams, Publishers Sinauer Associates, Inc.

15. Histology - A Text and Atlas, by M.H.Ross&E.J.Reith, The Williams and Wilkins Company.

16. Bailey's Text Book of Histology, revised by W.M. Copenhaver; The Williams and Wilkins Company.

17. Human Physiology, by R.F. Schmidt & G. Thews, Springer-Verlag.