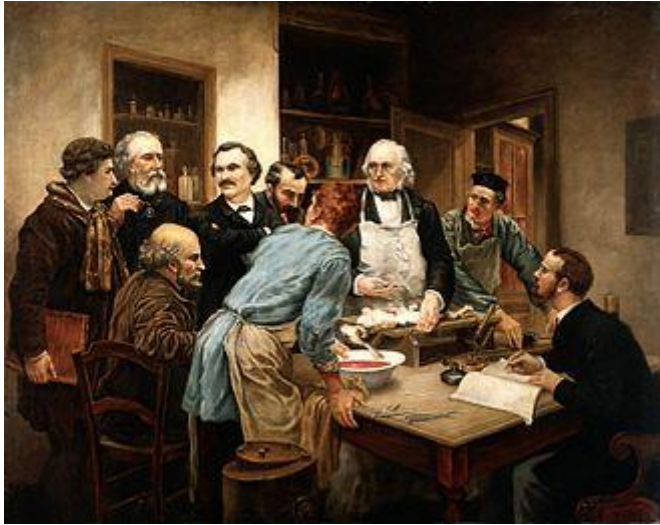


Physiology



Oil painting depicting Claude Bernard, the father of modern physiology, with his pupils

Physiology (/ˌfɪziˈɒlədʒi/; from Ancient Greek φύσις (*phúsis*) 'nature, origin', and -λογία (-*logía*) 'study of') is the scientific study of functions and mechanisms in a living system. As a sub-discipline of biology, physiology focuses on how organisms, organ systems, individual organs, cells, and biomolecules carry out the chemical and physical functions in a living system.^[4] According to the classes of organisms, the field can be divided into medical physiology, animal physiology, plant physiology, cell physiology, and comparative physiology.

Central to physiological functioning are biophysical and biochemical processes, homeostatic control mechanisms, and communication between cells.^[5] *Physiological state* is the condition of normal function, while *pathological state* refers to abnormal conditions, including human diseases.

The Nobel Prize in Physiology or Medicine is awarded by the Royal Swedish Academy of Sciences for exceptional scientific achievements in physiology related to the field of medicine.

What is physiology?

Physiology is the science of life. It is the branch of biology that aims to understand the mechanisms of living things, from the basis of cell function at the ionic and molecular level to the integrated behaviour of the whole body and the influence of the external environment. Research in physiology helps us to understand how the body works in health and how it responds and adapts to the challenges of everyday life; it also helps us to determine what goes wrong in disease, facilitating the development of new treatments and guidelines for maintaining human and animal health. The emphasis on integrating molecular, cellular, systems and whole-body function is what distinguishes physiology from the other life sciences.

Physiology is an experimental science. Research in physiology advances our understanding of the detailed mechanisms that control and regulate the behaviour of living things. We continue to learn more about fundamental processes, such as the control of heart rate or the sense of vision, through comprehensive exploration of the multiple processes involved.

Example 1: Electrical activity of the heart

Physiologists have studied how neurotransmitters modify the spontaneous electrical activity of the heart to bring about the changes in heart rate that we all experience when we exercise. Details of the electrical changes in the pacemaker cells of the heart itself are becoming well understood. The synthesis, breakdown and recycling of the neurotransmitters that mediate such changes and the location and gene-expression of the specific proteins they act upon are also targets for study.



Example 1



Example 2

Example 2: How eyes detect light

Physiologists seek to understand how the eyes detect light and thus inform the brain about the outside world. They study all the levels of the processes involved, from investigating how photons are captured by visual pigments in light-sensitive cells of the retina, to monitoring the integration of incoming signals in the visual cortex of the brain.

What do physiologists do?

All over the world, physiologists are working in universities, in research institutions, in biotechnology companies and in the pharmaceutical industry to advance our understanding of how the body functions. Physiology is an exciting and dynamic discipline that underpins translational and clinical medicine. It also provides the interface between the physical sciences and the life sciences.

Physiologists study every aspect of the way human and other animal bodies work. Some physiologists investigate the behaviour of individual proteins in single cells. Others are researching the interaction of cells in tissues, organs and systems or study the integration of these systems to control the whole complex organism. This work provides the foundation for many biological and clinical sciences, including medicine and veterinary science.

Not all physiologists are found in research laboratories, though. Physiologists also work with patients in hospital clinics, helping with the diagnosis and management of disease. They work alongside elite athletes, helping to improve their performance and avoid injury, or they investigate how the body adapts to extreme environmental challenges, such as deep-sea diving or prolonged space flight. Physiology is recognized globally. Physiologists can travel the world to conferences and meetings to present their findings to other scientists. Some physiologists report scientific developments for newspapers, journals and other media, or play an advisory role to Government or charitable organizations. Physiologists also use their skills in the legal arena, engaging in complex issues of patent law, or in education, inspiring and nurturing the next generation. Studying physiology opens doors to employment in all these areas and more. For more information about the range of careers and skills you can develop through a physiology degree,

Humans Physiology

Human physiology seeks to understand the mechanisms that work to keep the human body alive and functioning, through scientific enquiry into the nature of mechanical, physical, and biochemical functions of humans, their organs, and the cells of which they are composed. The principal level of focus of physiology is at the level of organs and systems within systems. The endocrine and nervous systems play major roles in the reception and transmission of signals that integrate function in animals. Homeostasis is a major aspect with regard to such interactions within plants as well as animals. The biological basis of the study of physiology, integration refers to the overlap of many functions of the systems of the human body, as well as its accompanied form. It is achieved through communication that occurs in a variety of ways, both electrical and chemical.

Changes in physiology can impact the mental functions of individuals. Examples of this would be the effects of certain medications or toxic levels of substances. Change in behavior as a result of these substances is often used to assess the health of individuals.

Much of the foundation of knowledge in human physiology was provided by animal experimentation. Due to the frequent connection between form and function, physiology and anatomy are intrinsically linked and are studied in tandem as part of a medical curriculum

Branches of physiology

By approach

- Applied physiology
 - Clinical physiology
 - Exercise physiology
 - Nutrition physiology
- Comparative physiology
- Mathematical physiology
- Yoga physiology

By organism

- Animal physiology
 - Mammal physiology
 - *Human physiology*
 - Fish physiology
 - Insect physiology
- Plant physiology

By process

- Developmental physiology
- Ecophysiology

- Evolutionary physiology

By subsystem

- Cardiovascular physiology
- Renal physiology
- Defense physiology
- Gastrointestinal physiology
- Musculoskeletal physiology
- Neurophysiology
- Respiratory physiology

The Human Physiology Syllabus of this autonomous college covers all most all of the relevant parts of this discipline. There are thousands of scopes after getting graduation degree from this subject physiology. From future research fields to applied fieldslike sports, industry, space, diagnostic fields to study fields; rather in one word any field related to human lifestyle systems.

PANSKURA BANAMALI COLLEGE

[Autonomous]



SYLLABUS FOR THREE-YEAR DEGREE COURSE

IN

PHYSIOLOGY HONOURS

UNDER

CHOICE BASED CREDIT SYSTEM (CBCS)

Course Components and Allotment of Credits

Semester	Name of the Course					Total Credits
	Core Course (CC)	Ability Enhancement Compulsory Course (AECC)	Skill Enhancement Course (SEC)	Discipline Specific Elective (DSE)	Generic Elective (GE)	
I	CC-1 CC-2	AECC-1	-	-	GE-1	20
II	CC-3 CC-4	AECC-2	-	-	GE-2	22
III	CC-5 CC-6 CC-7	-	SEC-A	-	GE-3	26
IV	CC-8 CC-9 CC-10	-	SEC-B	-	GE-4	26
V	CC-11 CC-12	-	-	DSE-A DSE-B	-	24
VI	CC-13 CC-14	-	-	DSE-C DSE-D	-	24
Total Course Number (Sem-I to Sem-VI)	Total Core Course-14 14×4=56 14×2=28 credits	Total Ability Enhancement Compulsory Course-2 2×2=4 credits 1×2=2 credits	Total Skill Enhancement Course-2 2×2=4 credits	Total Elective: Discipline Specific-4 4×4=16 4×2=8 credits	Total Elective: Generic-4 4×4=16 4×2=8 credits	142 (Total credits)

LIST OF CORE COURSES (CC)

CC 1: Cellular Basis of Physiology

CC 2: Biological Physics and Enzymes

CC 3: Physiology of Nerve and Muscle Cells

CC 4: Chemistry of Biomolecules

CC 5: Blood and Body Fluids

CC 6: Heart and Circulation

CC 7: Nervous System

CC 8: Energy Balance and Metabolism

CC 9: Gastrointestinal Physiology and Nutrition and Dietetics

CC 10: Respiration

CC 11: Special Senses

CC 12: Endocrinology

CC 13: Reproductive Physiology and Developmental Biology

CC-14: Renal Physiology, Skin and Body Temperature Regulation, and Environmental Pollutants and Human Health

LIST OF SKILL ENHANCEMENT COURSE (SEC)

SEC-A (One course in Semester III)

- SEC- 1: Computer Application
- SEC- 2: Physiological Techniques

SEC-B (One course in Semester IV)

- SEC- 3: Community Health
- SEC- 4: Clinical Biochemistry

LIST OF DISCIPLINE SPECIFIC ELECTIVES (DSE)

DSE-A (One Course in Semester V)

- DSE 1: Biostatistics
- DSE 2: Microbiology and Immunology

DSE -B (One Course in Semester V)

- DSE 3: Ergonomics and Occupational Physiology
- DSE 4: Community and Public Health

DSE -C (One Course in Semester VI)

- DSE 5: Work, Exercise and Sports Physiology
- DSE 6: Advanced Molecular Biology

DSE -D (One Course in Semester VI)

- DSE 7: Chronobiology and Stress Physiology
- DSE 8: Toxicology and Pharmacology

CC 1: CELLULAR BASIS OF PHYSIOLOGY

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

CC 1-T

Total Lecture-60

Cell Types – Eukaryotic, Prokaryotic. Electron microscopic structure and functions of the organ cells of eukaryotic cells: Structure of plasma membrane – Bio-chemical components, their arrangement, membrane asymmetry and fluidity; Functions; Fluid mosaic model. Membrane transport: active and carrier mediated transport: Mechanism of exocytosis and endocytosis. Structure functions and control of ion channels. Artificial membrane: Liposome and its functions. Endoplasmic reticulum: EM structure and function (Molecular basis) of smooth and rough ER. Microsomes: basic functional aspects. Golgi complex: structure, its functions, EM structure and functions of nucleus. Peroxisomes and its function. Mitochondria: EM structure and functions of nucleus. Ribosomes – Cytosol ribosomes and Mitochondrial ribosomes; their structure and functions. Cytoskeleton: structure and its role in stabilization of cell shape. Microtubules and their role in cellular movements and secretions. Events of Cell cycle; Apoptosis Cell differentiation; Gap junction, Tight junction (structure and functions): Cell adhesion molecule (brief), Cell division, mitosis, meiosis.

Structure, classification, distribution and functions of different tissues. Development and Organization of different organs and systems of the human body.

Basic principle and use of different microscopes - light, phase contrast. Electron microscopy, Atomic force microscopy and Fluorescence microscopy, Spectrophotometer.

CC 1-P: Histology

Study of Compound Light Microscope (Principle, Parts, & Function)

Study and Identification of Stained Sections of different Mammalian Tissue and Organs.

Bone, Cartilage, Trachea, Lungs, Spleen, Lymph gland, Oesophagus, 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, Uterus.

Cell viability test.

CC 2: BIOLOGICAL PHYSICS AND ENZYMES

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

CC 2-T

Total Lecture-60

Units for measuring concentration of solutes: Moles, Equivalent, Osmoles. Bonds and Forces in Biomolecules.

Biophysical and Biochemical Principles: Law of mass action, orders of reactions, properties of water, Significance and physiological application of the following phenomena: diffusion, osmosis, dialysis, surface tension, viscosity, adsorption, absorption, Colloids: properties and significances, sol and gel, lyophilic and lyophobic sol, electro kinetic properties; Isoelectric pH and isoelectric precipitation. Gibbs-Donnan membrane equilibrium and its biological importance. Acids and bases as proton donors and acceptors. Conjugate acid-base pairs: pH: definition, explanation, determination and significance; Buffers: definition, types; functions of buffers. Role of kidney, erythrocyte and lungs for maintaining body pH. Indicators and its applications. First and second laws of thermodynamics, closed and open system, living body as a thermodynamic system, entropy, enthalpy, maintenance of physiological steady state. Gibbs concept of free energy.

Flow and Pressure, Laminar and Streamline flow, and Ultracentrifugation

Spectrophotometer, ELISA, Principle of chromatography, ion exchange, gel filtration, GLC, TLC and immune-affinity chromatography. Electrophoresis: SDS-PAGE and agarose gel. Cell fractionation: Homogenization and ultrasonication, Differential and density gradient centrifugation for separation of cell fractions. Radio activity – use of radio isotopes in physiological studies. Nanoparticles and its application in Physiology (general concept)

Enzymes: Definition, chemical nature, classification and nomenclature. Mechanism of enzyme action – active site, specificity and enzyme-substrate complex formation. Enzyme kinetics: Hyperbolic kinetics and linear transformation (Lineweaver-Burk Plot; Woolf Hanes Plot; **Eadie-Hofstee diagram/plot**; *Eisenthal Cornish-Bowden Plot*). Michaelis – Menten constant. Effect of temperature, pH and metal ions on enzyme activity. Allosteric enzyme – Definition, properties, and types; Sigmoid kinetics. Regulation of enzyme activity – Allosteric modulation; Feedback and feed forward regulations; Covalent modification; Inhibition: Reversible-competitive, non-competitive and uncompetitive inhibition; Irreversible inhibition, Coenzyme and prosthetic groups; Activation of pro enzymes, Isoenzymes. Rate limiting enzymes. Ribozymes, Abzymes, Antizymes, Fundamental ideas about immobilized enzyme. Enzymes in clinical diagnosis (amylase, acid and alkaline phosphatase, SGOT, SGPT, LDH and CPK)

CC 2-P: Biological Physics and Enzymes

Demonstration of oncotic pressure of colloidal solutions by Oncometers. Determination of Systolic, Diastolic, Pulse and Mean Arterial Pressure by non-invasive methods (Auscultatory Methods). Determination of enzyme actions (e.g., CAT, Amylase). Effect of pH and temperature on enzyme actions (e.g., CAT, Amylase)

CC 3: PHYSIOLOGY OF NERVE AND MUSCLE CELLS
[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

CC 3-T

Total Lecture-60

Excitable Tissue: Nerve

Nerve Cells. Excitation and Conduction. Measurement of Electrical Events.

Ionic Basis of Excitation and Conduction. Properties of Mixed Nerves. Nerve Fibre Types and Function. Neurotrophins. Glia

Histo-anatomical structures of skeletal, smooth and cardiac muscles. Properties of muscles: Excitability and contractility, all or none law, summation of stimuli and contractions, genesis of tetanus, onset of fatigue, refractory period, tonicity, conductivity, extensibility and elasticity. Muscle proteins and Sarcotubular system of Human Skeletal and Cardiac Muscle. Mechanism of skeletal muscle contraction and relaxation. Isometric and isotonic contractions. Red and white muscles. Fast and slow twitch muscle fibres. Muscle length, Tension and Velocity relationships of skeletal muscle. Muscle groups: antagonists and agonists. Mechanical, chemical, thermal and electrical changes in striated muscle during contraction and relaxation. Motor unit and motor point. EM structure of Neuromuscular junctions, end-plate potential. Electromyography. Single and multi-unit smooth muscle and mechanism of smooth muscle contraction and relaxation. Factors affecting smooth muscle contraction.

Excitable Tissue: Muscle

Skeletal Muscle: Morphology. Electrical Phenomena and Ionic Fluxes. Contractile Responses. Energy Sources and Metabolism. Muscle heat. Properties of Muscle in the Intact Organism. Cardiac Muscle: Morphology. Electrical Properties. Mechanical Properties. Metabolism. Pacemaker Tissue. Smooth Muscle: Morphology. Visceral Smooth Muscle. Multi-Unit Smooth Muscle.

Synaptic and Junctional Transmission

Synaptic Transmission. Functional Anatomy. Electrical Events at Synapses. Inhibition and Facilitation at Synapses. Chemical Transmission of Synaptic Activity. Principal Neurotransmitter Systems. Synaptic Plasticity and Learning (brief). Neuro-Muscular transmission of impulse. Neuromuscular Junction. Denervation Hypersensitivity.

CC 3-P: Histological Study, Experiment of Nerve and Muscle

(With Principles, Procedure, & Detailed study of instruments involved in experiments.)

Isolation and Staining of nerve fibers with node(s) of Ranvier (AgNO_3) and muscle fibers (H and E).

Preparation of sciatic nerve innervated gastrocnemius muscle of toad. Study of Kymograph, Induction coil, Key and other instruments used to study mechanical responses of skeletal muscle. Kymographic recording of mechanical responses of gastrocnemius muscle to a single stimulus and two successive stimuli. Kymographic recording of the effects of variations of temperature and load (after-load) on single muscle twitch. Calculation of work done by the muscle. Determination of nerve conduction velocity.

CC 4: CHEMISTRY OF BIO-MOLECULES
[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

CC 4-T

Total Lecture-60

Carbohydrates: Definition and classification.

Monosaccharides– Classification, structure, stereoisomerism, optical isomerism, optical activity, epimerism. Cyclic structures- Pyranose and furanose forms, anomerism, mutarotation and its mechanism. Chemical reactions of monosaccharides (Glucose and Fructose) - Reactions with concentrated mineral acids, alkali, phenyl hydrazine and their biochemical importance. Derivatives of monosaccharides: Amino sugars, deoxy sugars, sugar alcohols, sugar acids, sugar esters, their biochemical and physiological importance.

Disaccharides– Maltose, Lactose and Sucrose: Structure, Occurrence, bio-chemical properties and Physiological importance.

Polysaccharides– Starch, Glycogen, Dextrin, Cellulose, Glycosaminoglycans, Glycoproteins, Sialic acids, Lectins, Blood group polysaccharides.

Lipids: Definition and classification. Fatty acids: Classification, systemic nomenclature and structure. Mono-, Di- and Triglycerides. Properties of Fat and Fatty acids Hydrolysis, Saponification, Saponification number, Iodine number, Acetylation - Acetyl number. Hydrogenation, Rancidity - Acid number, Reichert-Meissl number. Cis-trans isomerism. Eicosanoids, Phospholipids, Glycolipids, Sphingolipids, Cholesterol & its ester - their structure and physiological importance. Lipoproteins - Structure, classification and physiological importance.

Amino acids and Proteins:

Amino acids: Classification, Structure, Nomenclature and Optical properties. Protonic equilibrium of amino acids – amphoteric nature, 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 (Covalent bonds, Ionic and hydrogen bonds, Van der Waals forces and hydrophobic interactions). Denaturation and Renaturation reactions.

Purine and Pyrimidine: Structure, nomenclature and tautomerism.

Nucleic acids: Nucleosides and Nucleotides - structure. Polynucleotides. DNA double helix - Primary, Secondary and Tertiary structure. A-DNA, B-DNA and Z-DNA. RNA - Structure and types. Denaturation and annealing of DNA. Hyperchromicity, melting temperature and half C^0t value.

CC 4-P: Biological Chemistry

Qualitative tests for the identification of physiologically important substances: Hydrochloric acid, lactic Acid, Uric Acid, Albumin, Gelatine, Peptone, Glucose, Galactose, Fructose, Sucrose, Lactose, Starch, Dextrin, glycogen, Urea, Glycerol, Bile salts, acetone.

CC 5: BLOOD AND BODY FLUIDS
[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

CC 5-T

Total Lecture-60

Basic idea about intracellular and extracellular compartments of body fluid. Water: intake and excretion. Volumes of body water in different compartments and their estimation. Water balance and its regulation. Dehydration and oedema.

Composition and function of Blood. Plasma proteins: Classification, normal value, origin and functions Plasmapheresis. Erythrocytes: Morphology, fate and functions; Steps of erythropoiesis, role of different factors on erythropoiesis. Haemoglobin: chemistry, biosynthesis, functions, catabolism; derivatives like oxyhaemoglobin, methemoglobin, carboxy haemoglobin and hemin. Foetal haemoglobin. Abnormal haemoglobin: thalassemia, sickle cell anaemia. Normal value and clinical significance of ESR, TC, DC, PCV, MCH, MCHC, MCV. Anaemia: megaloblastic and microcytic, pernicious, aplastic, hypochromic. Polycythaemia. Blood groups: ABO system; Rh-antigens, blood transfusion and its hazards. Blood group incompatibility- erythroblastosis fetalis. Leucocytes: Morphology, classification, life cycles, functions. Significance of Arnehtcount, Schilling index, reticulocyte count. Platelet- Morphology, life cycles, functions. Significance of platelet count. Haemostasis- Coagulation factors, mechanism of blood coagulation, anticoagulants (natural and artificial) and their mode of action, coagulation time, bleeding time, prothrombin time, haemolysis. Disorders of haemostasis. Haemophilia, thrombosis and embolism. Blood volume: Normal values, determination by dye method and isotope method and factors influencing blood volume. Regulation of blood volume.

Lymph and tissue fluid: Anatomical organization of lymphatic system. Formation, composition, circulation, functions and fate of lymph and tissue fluid. Splenomegaly causes and effects.

CC 5-P: Haematological experiments

Preparation of hemin crystal. Determination of coagulation time by capillary method. Bleeding time (Duke Method), Blood grouping, Rh typing. Preparation and staining of human blood film (Leishman); Identification and measurement of WBC. Differential count of WBC, Arneht count, platelet count, total count of RBC and WBC. Staining of reticulocyte. Estimation of haemoglobin (visual method) and cyanmethaemoglobin method. Determination of haematocrit value, calculation of red blood cell indices (MCV, MCH and MCHC). Study of bone marrow for identification of megakaryocytes.

CC 6: HEART AND CIRCULATION
[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

CC 6-T

Total Lecture-60

The Heart as a Pump

Anatomy of the heart. Properties of cardiac muscle. Cardiac Innervation. Stannius ligature. Mechanical Events of the Cardiac Cycle. The cardiac cycle- pressure and volume changes. Heart sounds. Murmurs. Cardiac Output. Cardiac output– measurement by application of Fick’s principle and dye dilution method, factors affecting. Starling’s law of heart.

Origin of the Heartbeat and the Electrical Activity of the heart

Origin and spread of cardiac excitation. Cardiac action potential. Origin and propagation of cardiac impulse. The Electrocardiogram. Electrocardiography –the normal electrocardiogram, electrocardiographic leads, vectorial analysis, the vectorcardiogram, the mean electrical axis of heart. The His bundle electrogram. Cardiac Arrhythmias. Cardiac Arrhythmias – Normal cardiac rate. Myocardial Infarctions. Cardioplegic solutions. Electrocardiographic Findings in Other Cardiac and Systemic Diseases, hypertrophy and cardiac myopathy.

Dynamics of Blood and Lymph Flow

Anatomic Considerations. Functional morphology of arteries, arterioles, capillaries, venules and veins, sinusoids. General pattern of circulation and significance of branching of blood vessels. Biophysical Considerations. Hemodynamics of blood flow. Arterial and Arteriolar Circulation. Capillary Circulation. Lymphatic Circulation & Interstitial Fluid Volume. Venous Circulation.

Cardiovascular regulatory Mechanisms

Local Regulatory Mechanisms. Cardiac and vasomotor centers, baroreceptors and chemoreceptors, cardiac and vasomotor reflexes. Substances Secreted by the Endothelium. Systemic Regulation by Hormones. Systemic Regulation by the Nervous System. Cardiovascular homeostasis–neural and chemical control of cardiac functions and blood vessels.

Circulation Through special Regions

Cerebral Circulation. Anatomic Considerations. Cerebrospinal Fluid. Cerebrospinal Fluid. The Blood-Brain barrier. Cerebral Blood Flow. Regulation of Cerebral Circulation. Brain Metabolism and Oxygen

Requirements. Coronary Circulation. Splanchnic Circulation. Circulation of the skin. Placental & Fetal Circulation

Cardiovascular Homeostasis in Health and Disease

Compensation for Gravitational Effects. Exercise. Inflammation and Wound Healing. Shock. Cardiovascular adjustment after haemorrhage. Hypovolemic and hypervolemic shock. RTI and atherosclerosis. Hypertension. The pulse – arterial and venous. Blood pressure– its measurement and factors affecting. Heart Failure, stroke

CC 6-P: Cardiovascular Physiology Experimental

Preparation of Amphibian Ringer solution. Kymographic recording of the movements of perfused heart of toad. Study of the effects of changes in perfusion fluid pressure, changes in temperature, excess calcium and potassium ion concentration, acetylcholine, adrenaline on the on the movement of heart.

CC7: THE NERVOUS SYSTEM

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

CC 7-T

Total Lecture-60

Gross anatomy of Brain and spinal cord:

Components and gross structure of prosencephalon, mesencephalon and rhombencephalon, cranial nerves. Cross sectional view of spinal cord, lamellar structure of central grey of spinal cord (Rexed lamella), spinal nerves.

Reflexes

Monosynaptic Reflexes: The Stretch Reflex. Polysynaptic Reflexes: The Withdrawal Reflex. General Properties of Reflexes

Arousal Mechanism, Sleep and the Electrical Activity of the Brain

The Reticular Formation and the Reticular Activating System. Reticular formation: organization, connection and functions of ascending and descending reticular formation. Physiological basis of sleep and wakefulness. The Thalamus & the Cerebral Cortex. Evoked Cortical Potentials. The Electroencephalogram. Physiological Basis of the EEG, Consciousness, and Sleep. Interpretation of abnormal EEG pattern

Control of Posture and Movement

General Principle. Corticospinal and Corticobulbar System. Anatomy and Function. Posture and its regulation. Decerebrate rigidity, Decorticate rigidity, Postural reflexes and regulation of Posture. Basal Ganglia. Cerebellum. Movement disorders

The Autonomic Nervous System

Anatomic Organization of Autonomic Outflow. Chemical Transmission at autonomic Junctions. Responses of Effector Organs to Autonomic Nerve Impulses. Cholinergic and Adrenergic autonomic nerves

Central Regulation of Visceral Function

Medulla Oblongata. Hypothalamus: Anatomic Considerations, Hypothalamic Function, Relation to Autonomic Function, Relation to Sleep, Relation to Cyclic Phenomena, Hunger, Thirst, Control of Posterior Pituitary Secretion, Control of Anterior pituitary Secretion, Temperature Regulation, fever

Neural Basis of Instinctual Behaviour and Emotions

Anatomic Considerations. Limbic Functions. Limbic system: structure, connections and functions. Physiology of emotion. Sexual Behaviour. Fear & Rage. Motivation

Higher Functions of the Nervous System

Functions of the Neocortex, Cognitive functions: Learning & Memory. Disorders relating to learning and memory. Speech and speech disorders. Asymmetric functions of cerebral hemispheres, split brain.

Cerebrospinal fluid:

Composition, formation, circulation and absorption of CSF. Blood brain barrier. Hydrocephalus.

Molecular Neurophysiology: Ionotropic and metabotropic channels. Structure and functions of nicotinic acetylcholine receptor and muscarinic receptor, alpha and beta adrenoceptors, NMDA and AMPA receptors.

CC 7-P: Neurological Experimental

Experiments on superficial (plantar) and deep (knee jerk) reflex. Measurement of grip strength. Reaction time by stick drop test. Short term memory test (shape, picture word). Two point discrimination test.

CC 8: ENERGY BALANCE AND METABOLISM

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

CC 8-T

Total Lecture-60

Metabolism of Bio-molecules

Carbohydrate Metabolism: Glycolysis, R-L cycle, TCA cycle, Gluconeogenesis, Cori cycle, Glucose-Alanine cycle. Pentose Phosphate Pathway, Glycogenesis and Glycogenolysis. Inborn errors or metabolism of glycogen, galactose.

Biological Oxidation: Concept of substrate-level phosphorylation and oxidative phosphorylation, Redox Potential and redox couple. Mitochondrial Electron Transport Chain and its components. Mechanism of electron transport and ATP synthesis. Oxidative Phosphorylation, Inhibitors and uncouplers.

Lipid Metabolism: β -oxidation of saturated fatty acids (Palmitic acid), ω and β oxidation biosynthesis of saturated fatty acid (C16). Formation and fate of ketone bodies. Metabolism of Triglycerides. Biosynthesis and catabolism of lecithin, cephalin and sphingomyelin. Brief concept of cholesterol biosynthesis and its physiological significance. Metabolism of adipose tissue. Role of lipoproteins in transport and storage of lipids.

Amino Acids Metabolism: Glucogenic and ketogenic amino acids and amino acid pool. Non protein nitrogen. Transamination, oxidative and non-oxidative deaminations. Ammonotelic, ureotelic and uricotelic organisms. Metabolism of glycine, sulphur containing amino acids tryptophan and tyrosine, Synthesis of specialized products from amino acids (viz., catecholamines, creatine phosphate, nicotinamide, histamine, serotonin and melatonin, melanin, gamma-aminobutyrate, taurine and

glutathione). Inborn errors or metabolism of tryptophan, phenylalanine and tyrosine. One carbon metabolism, labile methyl group and transmethylation. Synthesis of Urea and Nitric oxide.

Purine and Pyrimidine Metabolism: Purines and Pyrimidines: Biosynthesis - de novo and salvage pathways. Catabolism. (Regulation of the above mentioned biochemical pathways/cycle not required).

Mineral metabolism: Sodium, potassium, chloride, calcium and phosphorus metabolism. Trace elements (iron, iodine, fluorine, selenium) - their functions and deficiencies.

CC 8-P: Biochemical Estimation

Quantitative estimation of glucose and sucrose by Benedict's method. Quantitative estimation of amino nitrogen (Sorensen's formol titration method [percentage as well as total quantity to be done]). Estimation of percentage quantity of lactose in milk by Benedict's method. Determination of strength of NaOH, HCl and H₂SO₄ by titration against oxalic acid. Quantitative estimation of chloride by Mohr's method, amino nitrogen by formol-titration method. Assay of enzymes and TLC: Determination of optimum pH, temperature, V_{max} and K_m value of enzyme (amylase through 3, 5 dinitro salicylate reagent). Chromatography: Identification of amino acid and sugar through TLC or paper chromatography.

CC 9: GASTROINTESTINAL PHYSIOLOGY [TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

CC 9-T

Total Lecture-60

Gastrointestinal Physiology:

Histology and functions of digestive organs - tongue, pharynx, oesophagus, stomach, small intestine, large intestine, pancreas, liver, gall bladder and salivary glands. Nerve supply to the alimentary system. Mechanism, functions and regulation of mastication, deglutition, movement of the alimentary canal. Anatomy and histology of alimentary canal, Deglutition and Movements of alimentary canal and their regulations. Digestive glands – histological structures of salivary glands, pancreas and liver. Composition, functions, mechanism of secretion and control of saliva, gastric juice, pancreatic juice, bile and intestinal juice. Mechanism and control of gastric HCl secretion. Synthesis of Bile acids. Functions of gall bladder and large intestine. Mechanism and importance of Enterohepatic circulation of bile. Feces and defecation. GALT, MALT. Basic concepts of Peptic Ulcer, Jaundice and Gall-stones Cholelithiasis. Gastrointestinal hormones. Defecation reflex, vomiting reflex.

Digestion and Absorption of Carbohydrates, Proteins and Nucleic Acids, Lipids. Absorption of Water and Electrolytes. Absorption of Vitamins & Minerals.

Nutrition and Dietetics:

Basic concept: Nutrition, Nutrients, Nutraceutical, Cosmeceuticals, Nutrigenomics.

Nutritional Evaluation of Carbohydrates: Glycaemic Index (GI), Classification of dietary fibers with potential of health benefit, Resistance starch as prebiotics- Fructo - oligosaccharide, Galacto - oligosaccharide, soy - oligosaccharide, Nutritive value of major carbohydrate like rice, wheat, roots, tubers, leafy vegetables, red-yellow vegetables and fruits.

Nutritional Evaluation of Proteins: Essential and Non essential amino acids, Protein Efficiency ratio (PER), nitrogen balance, Net protein utilization (NPU), Biological value of protein, protein spares, Nutritive value of protein food stuffs like pulses, egg, fish, meat, milk, soybeans.

Nutritional Evaluation of Fats: essential fatty acids, saturated and unsaturated fatty acids, Dietary requirement of fat, Non-glyceride edible oil, Nutritive value of fat food stuffs like egg, fish, milk, edible oils, nuts.

Vitamins: Water soluble vitamins (Vit-B complex, Vit- C, Folic acid) and fat soluble vitamins (Vit-A, D, E and K): source, brief chemistry, dietary requirements, functions, deficiency, hypervitaminosis, antioxidant.

Energy in Human Nutrition: Basic concept of energy and units, calorific and physiological fuel value, respiratory quotient (RQ), Total energy expenditure (TEE), Basal metabolic rates (BMR) and Resting energy expenditure (REE), Specific dynamic action (SDA), physical activity ratio (PAR), Determination of BMR by Benedict Roth apparatus and WHO/ ICMR prediction equation, Factors affecting BMR, Adult consumption unit (ACU), determination of energy requirements of Indians in different age groups by doubly labeled water (DL W) method and prediction equation method.

Formulation of Diet chart: Basic principle of diet chart. ICMR specified food groups (Five Group Plans, Nine Group Plan and 11- Group Plan), Food guide pyramid. Formulation of balance diet chart for vegetarian and non vegetarian, infant, growing child, sedentary adults, moderate working adults, college students, pregnant and lactating mother and athletes in low and moderate socio economic status.

Space Nutrition: change of body composition, energy recommendation for space flights, space food system, types of space foods.

CC 9-P: Experiments with Dale's Apparatus

Kymographic recording of normal movements of rat's intestine in Dale's apparatus. Effects of hypoxia, acetylcholine and adrenaline on normal intestinal movements

Identification of food adulterants: starch from milk, dalda from butter, saw dust and colouring agents from spices, saccharine in sugar.

CC10: RESPIRATION

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

CC 10-T

Total Lecture-60

Anatomy and histology of the lung and airways.

Mechanics of breathing: Mechanism of respiration and the role of different respiratory and accessory muscles. Compliance, elasticity and elastic recoil of the lung. Role of lung surfactants. Intra-thoracic and intra-pleural pressures.

Spirometry: Lung volumes and capacities. Dead space.

Pulmonary Circulation: Ventilation- perfusion ratio.

Transport of gases in body: Partial pressures and percentage of respiratory gases in inspired, expired, alveolar air and in blood. Respiratory gases and their exchange between the lung alveoli and blood and between the blood and the tissues. Transport of Oxygen and Carbon dioxide in blood. Oxygen

dissociation curve of haemoglobin and myoglobin, Carbon dioxide dissociation curve and factors affecting. Respiratory acidosis and alkalosis.

Regulation of respiration: neural and chemical respiration, respiratory centers, chemoreceptors, baroreceptors, pulmonary receptors.

Respiratory Adjustments in Health and Disease: Effects of Exercise. Respiratory failure, artificial respiration and its different techniques (mouth to mouth, tank respirator method). Oxygen Treatment. Respiratory Abnormalities-Hypoxia, asphyxia, dyspnea, asthma, cardiac and bronchial emphysema, cyanosis, dysbarism, coughing and sneezing. Hypercapnia and Hypocapnia. Effects of Increased Barometric Pressure. Lung functions tests. Non respiratory functions of lung – Airway defence, Immune system defence and biosynthetic functions.

CC 10-P: Experiments on Respiratory Physiology

Measurement of peak expiratory flow rate. Measurement of oxygen saturation by pulse oximeter before and after exercise. Spiro-metric measurement of vital capacity. Pneumographic effects of talking, laughing, coughing, exercise, hyperventilation and breath holding.

CC 11: SPECIAL SENSES

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

CC 11-T

Total Lecture-60

Characteristics of special senses, Sensory Coding - Weber-Fechner law, Steven's power law.

General Senses: Classification, distribution, function and neural pathway of touch, pressure, pain, thermal and kinaesthetic sensation.

Vision: Anatomy and structures of the eyeball. Histological details of retina, peripheral retina, fovea and blind spot. Retinal detachment. Visual pathway and centres. Effects of lesion in visual pathway. Mechanism of accommodation. Errors of refraction and their corrections. Formation and Circulation of

Aqueous Humour. Cataract and Glaucoma. Photopic and scotopic vision. Chemical and electrical changes in retina on exposure to light. Visual processing in the retina. Positive and negative after- images. Contrast phenomenon. Light and dark adaptation. Colour vision—Trichromatic, Single and Double Opponent mechanism. Colour blindness. Visual field-- perimetry. Visual acuity – measurement, mechanism and factors affecting. Critical fusion frequency- Ferry-Porter law.

Audition: 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. Olfactory and Gustatory Coding. Abnormalities of olfactory and taste sensation.

CC 11-P: Histological Techniques and Human Experiments

Tissue preparation, section cutting, staining and identification of histological slides and submission of five histological slides duly signed by teacher. Determination of visual acuity by Snellen's chart / Landolt's C chart. Determination of colour blindness by Ishihara chart. Determination of Deafness by Tuning Fork Tests.

CC 12: ENDOCRINOLOGY

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

CC 12-T

Total Lecture-60

Concept and definition of endocrine systems, glands and hormones. Experimental and clinical methods of study of endocrine glands. General classification of hormones on chemical basis. Concepts of hormone receptors and cell signalling. Mechanisms and Modern Concept of hormone actions: G-protein, Cyclic

AMP, cGMP, IP3-DAG, Ca²⁺, Tyrosine Kinase, JAK-STAT pathway and nuclear receptor mediated action.

Hypothalamo-hypophysial axis: Feedback regulation, Hypothalamus as a neuroendocrine organ, Releasing Factors, Tropic hormones of hypothalamus. Vascular and neural connections between the hypothalamus and the pituitary, role of median eminence.

Histological structures, functions, and regulation of anterior, middle and posterior lobes of pituitary. Chemistry, modes of action and functions of growth hormone, TSH, ACTH, FSH, LH, Prolactin, MSH, Vasopressin and Oxytocin. Cushing's disease, gigantism, acromegaly, dwarfism, Simmonds' disease, Froelich's syndrome, diabetes insipidus.

Thyroid Gland: Electron microscopic structure of thyroid gland. Thyroid hormone: Chemistry, Biosynthesis, Storage and Transport. Functions of T₄ (Thyroxine) and T₃ (Triiodothyronine). Regulation of Thyroid hormone secretion. Clinical Correlates. Cretinism. Myxoedema. Grave's disease. Hashimoto's disease. Iodine deficiency goitre.

Endocrine Functions of the Pancreas and the Regulation of Carbohydrate Metabolism:

Histological structure of pancreatic islets. Structure, biosynthesis, secretion and regulation of insulin and glucagon. Modes of action and functions of insulin and glucagon. Insulin Excess. Other Islet Cell Hormones. Hypoglycaemia and Diabetes Mellitus in Humans.

The Adrenal Medulla and Adrenal Cortex: Introduction. Adrenal Morphology

Adrenal Medulla: Structure and function of Adrenal Medullary Hormones. Regulation of Adrenal Medullary Secretion. Synthesis and metabolism of catecholamine hormones. Actions of adrenaline and nor-adrenaline on different organs and their effect. Pheochromocytoma

Adrenal Cortex: Structure and biosynthesis of Adrenocortical hormones. Effects of Adrenal Androgens and Estrogens. Physiologic Effects of Glucocorticoids. Pharmacologic & Pathologic Effects of Glucocorticoids. Regulation of Glucocorticoid Secretion. Effects of Mineralocorticoids. Regulation of Aldosterone Secretion. Summary of the effects of Adrenocortical hyper and hypo function in humans.

Hormonal Control of Calcium Metabolism and the Physiology of Bone:

Introduction. Calcium and Phosphate Metabolism. Bone Physiology. Vitamin D and the Hydroxycholecalciferols. The Parathyroid Glands. Calcitonin. Effects of other hormones and Humoral Agents on Calcium metabolism.

Endocrine Functions of the Kidneys, Heart, and Pineal Gland

Introduction, The Renin-Angiotensin System, Erythropoietin, The Endocrine Function of the Heart: Atrial Natriuretic Peptide, Pineal Gland.

CC 12-P: Assay of hormones

Study of the effects of oxytocin on uterine contraction. Study of the effects of adrenaline on intestinal / uterine movements.

CC13: REPRODUCTIVE PHYSIOLOGY
[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

CC 13-T

Total Lecture-60

Primary and accessory sex organs and secondary sex characters.

Sex Differentiation and Development. Chromosomal Sex. Embryology of the Human Reproductive System. Aberrant Sexual Differentiation. Puberty. Precocious and Delayed Puberty. Menopause.

Pituitary Gonadotropins and Prolactin

The male reproductive System: Structure. Histology of testis. Gametogenesis and Ejaculation.

Endocrine function of the testes. Control of testicular function. Prostate and seminal vesicle. Abnormalities of testicular function.

The Female Reproductive system: Histological structure of ovary, Graafian follicle and Corpus luteum, chemical nature and functions of Oestrogen and Progesterone. Hormonal control of ovarian functions. Menstrual cycles and its hormonal control. Formation, Maturation of Ovum. Physiological Mechanism of Ovulation. Abnormalities of ovarian function. Basic concepts of ovarian cysts. Abnormalities in menstrual cycle. Onset of menopause and post-menopausal changes, Postmenopausal syndromes. Oestrous cycle.

Pregnancy: Transport of ovum and sperm in female reproductive tract. Fertilization. Uterine implantation of fertilized ovum. Formation, structure, functions and fate of placenta. Placental hormones. Changes during pregnancy and their hormonal control. Pregnancy tests (immunological). Parturition, Ectopic pregnancy.

Lactation and Mammary Gland: Anatomical Histological structure of mammary gland. Phases of mammary development and their hormonal control. Hormonal control of lactation and milk ejection reflex.

Physiological concepts for a planned family

Embryology

Cleavage, Embryogenesis, morula, blastula, gastrula and blastocyst. Formation of trilaminar germ disc. Development of Alimentary system, Heart and Urogenital system. Foetal circulation and its changes after birth. Basic concept of stem cell biology.

CC 13P: Reproductive Histology and Biochemistry

Study of oestrous cycle. Estimation of oestrogen by spectrophotometric method. Pregnancy test from human urine by kit method. Sperm count, sperm viability test by using eosin-Y

CC-14: RENAL PHYSIOLOGY, SKIN AND BODY TEMPERATURE REGULATION, AND ENVIRONMENTAL POLLUTANTS AND HUMAN HEALTH

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

CC 14-T

Total Lecture-60

Renal Physiology: Gross structure of kidney. Microanatomy (including electron microscopy) of a nephron and structural differences between cortical and juxtamedullary nephrons. Juxtaglomerular apparatus. Mechanism of urine formation: Concept of ultrafiltration, glomerular filtration rate, reabsorption by passive and active tubular transport. Concept of counter current system, counter current multiplier, exchanger and mechanism of concentrated urine formation. Acidification of the urine and bicarbonate excretion. Regulation of Na⁺ and Cl⁻ excretion. Non-excretory functions of kidney. Renal Circulation peculiarities and autoregulation. Diuretics. Disorders of Renal Functions. Renal function tests (creatinine, inulin, urea and PAH clearance tests). Concept of renal threshold. Diabetes insipidus. Normal and abnormal constituents of urine and their clinical significance. Renal stone formation. Dialysis and artificial kidney. Filling of the urinary bladder. Emptying of the urinary bladder. Innervations of urinary bladder and micturition, micturition reflexes and its regulation by higher centers.

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 homeotherms – its physical and physiological processes, roles of neural and hormonal processes. Pyrexia, hyperthermia and hypothermia.

Environmental Pollutants and Human Health: Environment- Its physiological aspects. Effects of exposure to hot and cold environment. Acclimatization to hot and cold environment. Heat disorders and their preventive measures. Mountain sickness. Acclimatization to high altitudes. Preventive measure against hypobaric and hyperbaric effects. Physiological effects and preventive measures against G force, noise, vibration and radiation-. Types of pollutants (primary, secondary and tertiary), sources, mechanism of action and effects of metabolic pollutants, neurotoxin, mutagen, carcinogen, teratogens. Heavy metal toxicity (Pb, Hg, Cd, As). Air and water pollutions – sources, effects and control. Brief idea about biotransformation, bioaccumulation, bio-magnification and health hazards of pesticides. Basic concept of population over growth and their effects on health. Elementary idea about xenobiotics and their effects.

CC 14-P: Renal Physiology and Environmental Pollutants

Identification of normal and abnormal constituents of urine.

Determination of O₂, CO₂, BOD and COD. Determination of total alkalinity, Ca, Mg and chlorine in water by titration method. Assessment of environmental heat load. Assessment of noise level using noise level meter. Determination of light intensity (at library, laboratory & class room) by lux meter.

Skill Enhancement Course (SEC)

SEC-A (One course in Semester III)

SEC- 1: Computer Application

SEC- 2: Physiological Techniques

SEC-B (One course in Semester IV)

SEC- 3: Community Health

SEC- 4: Clinical Biochemistry

SEC-A

SEC- 1: Computer Application

Basic application of computer in physiological data analysis- M.S. Word, Excel, Power-Point: Preparation of body text and table by using MS word, Graphical representation of data in pie, bar and line diagram using Microsoft Excel, presentation of study material by using power point. Computation of data-mean, median, mode, SD, SEM, t-value.

SEC- 2: Physiological Techniques

Audiometry, Perimetry, ECG, EMG, EEG, Nerve conduction velocity, Autonomic status assessment (Valsalva manoeuvre), Deep breathing test, Reaction time (Choice), Stereotaxic techniques

SEC-B

SEC- 3: Community Health

Nutritional status of children and adults: Growth curves (Height-for-age, Weight-for-age, weight-for-height, BMI-for-age) for detection of stunting, underweight, wasting, thinness, overweight and obesity. Somatotype for adult (Heath-Carter method). Socioeconomic status assessment (kuppuswamy's socioeconomic scale)

SEC- 4: Clinical Biochemistry

Physiological importance and measurements of serum total protein, thyroxine, ferritin, trans ferritin, prolactin, uric acid, bilirubin, CKP, catalase, amylase, SOD. Estimation of acid and alkaline phosphatase, SGOT & SGPT of supplied blood.

Discipline Specific Electives (DSE)

DSE-A (One Course in Semester V)

DSE 1: Biostatistics

DSE 2: Microbiology and Immunology

DSE -B (One Course in Semester V)

DSE -3: Ergonomics and Occupational Physiology

DSE 4: Community and Public Health

DSE -C (One Course in Semester VI)

DSE 5: Work, Exercise and Sports Physiology

DSE 6: Advanced Molecular Biology

DSE -D (One Course in Semester VI)

DSE 7: Chronobiology and Stress Physiology

DSE 8: Toxicology and Pharmacology

DSE-A (One course in Semester V)

DSE 1: BIOSTATISTICS

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

DSE 1-T

Total Lecture-60

Scope of statistics – utility and misuse. Principles of statistical analysis of biological data. Basic concepts – variable. Population and Sampling - parameter, statistic. Presentation of data-frequency distribution, frequency polygon, histogram, bar diagram and pie diagram. Different classes of statistics- mean median, mode, mean deviation, variance, standard deviation, standard error of the mean. Standard score. Degrees of freedom. Probability. Normal distribution. Student's t-distribution. Testing of hypothesis - Null hypothesis, errors of inference, levels of significance, t-test and z score for significance of difference. Distribution-free test - Chi-square test. Linear correlation and linear regression. One way ANOVA

DSE 1-P

Computation of mean, median, mode, standard deviation and standard error of the mean with physiological data like body temperature, pulse rate, respiratory rate, height and weight of human subjects. Graphical representation of data in frequency polygon and histogram. Student's t test for significance of difference between means. Chi-square test for categorical variables. Determination of correlation coefficient (r) and computation of linear regression equation. Statistical analysis and graphical representation of biological data with computer using One-way ANOVA

DSE 2: MICROBIOLOGY AND IMMUNOLOGY

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

DSE 2-T

Total Lecture-60

Classification of microorganisms. Techniques employed for the identification of microorganisms - microscopic and biochemical methods.

Control of microbial growth: Physical and Chemical methods used in sterilization, disinfection and pasteurization.

Bacteriology: Bacterial classification based on staining techniques (Gram stain and Acid-fast stain) and morphological aspect. Bacterial structure: cell-wall, LPS layer, pili, flagella, chromosome, plasmid, spores and cysts.

Culture of bacteria: Nutritional requirement – complex and synthetic media, preparation of media; physical factors required for growth (temperature, pH and gaseous requirement); bacterial growth curve: different phases and their significance; quantitative estimation of bacterial growth; continuous growth culture and its utility.

Food microbiology: Beneficial and harmful microorganisms in food, causative organisms of food-borne infections- mode of transmission and methods of prevention.

Bacterial metabolism: Fermentation, Glyoxalate cycle and EntnerDoudoroff pathway.

Bacterial genetics: Transformation, conjugation and transduction.

Treatment of bacterial infection: Chemotherapeutic agents. antibiotics- definition, bactericidal and bacteriostatic and their mechanism of action.

Virology: Viral structure – virion, prion and bacteriophages; classification of viruses based on nucleic acid composition and host system, replication of bacteriophages – lytic and lysogenic cycle.

Overview of innate and acquired immunity: Elements of acquired immunity: Characteristics of immune response, cells and organs involved in immune response.

Immunogens and antigens: Requirements of immunogenicity, epitopes recognized by B- and T- cells, haptens, adjuvants, cross-reactivity. Antibody structure, classification and functions.

Kinetics of antibody responses: Primary and secondary. Antigen – antibody interactions - Primary interaction: association constant, affinity and avidity. Secondary interaction: precipitation and agglutination. B-cell receptor.

MHC molecules: Structure of class I and II molecules, brief idea of peptide binding by MHC molecules, cellular distribution.

Antigen processing and presentation: T-cell receptor. T-cell maturation and differentiation - thymic selection in brief. B-cell activation and differentiation: thymus dependent and independent antibodies, T- B co-operation, the carrier effect.

Cytokines: Produced by TH1 and TH2 cells, regulating specific immune response only.

Complement: Activation components – classical, alternative and lectin.

Biological consequence of complement activation. Cell-mediated effector responses : CTLs, NK cells, K cells.

Brief idea of autoimmunity, cancer immunotherapy and AIDS. Hypersensitivity reactions and their types.

Vaccination: Passive and active immunization, types and uses of vaccine.

Toxins and toxoids.

Hybridoma technology

DSE 2-P

Gram staining of bacteria and identification of Gram positive and Gram negative bacteria. Determination of human blood group using immunological method. Quantitation of antigen or antibody by precipitin test. Isolation and staining of splenocytes. Lactophenol cotton blue staining of yeast cells.

DSE-B(One course in Semester V)

DSE-3: ERGONOMICS AND OCCUPATIONAL PHYSIOLOGY

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

DSE 3-T

Introduction to Ergonomics

Total Lecture-60

A brief history of ergonomics Multidisciplinary approach to Ergonomics Definition and scope of Ergonomics. Role of ergonomics in health safety and productivity.

Human machine interaction

Introduction to man machine interaction and interfaces. Fundamentals of human computer interaction. Fundamental idea of display and control.

Anthropometric considerations in Ergonomics

Definition of anthropometry. Common terminologies used in anthropometry. Different body dimensions measured in anthropometry. Basic Concepts of reach, clearance, posture, range of motion. Concept of percentile and its calculation and use of percentile values in anthropometry.

The work place

Workplace components. Work place stressors and work place risk factors.

Environmental Ergonomics

Ergonomic consideration of thermal environment. Ergonomic consideration of visual environment. Ergonomic consideration of environmental noise.

Workplace and workplace design

Anthropometric principles in workplace design. Design principles for sitting and standing work.

Ergonomic principles of load handling

Fundamentals of manual material handling. Different categories of movement in manual load handling. Ergonomic principles of safe load handling.

Musculoskeletal Disorders

Basic idea about the role of skeletal system in movement, categories of joints, role of muscles, soft tissues and bones in movement. Risk factors for musculoskeletal disorders. Different types of musculoskeletal disorders. Evaluation of musculoskeletal disorders by questionnaire technique. Basic concept of OWAS method of work posture analysis.

Ergonomic intervention

Ergonomic principles of reducing work place stressors and improving work efficiency.

DSE 3-P

Determination of heat stress by WBGT indices. Assessment of Illumination. Basic anthropometric measurements. Determination of range of motion by goniometer and strength by hand grip Dynamometer. Assessment of prevalence of musculoskeletal disorder by questionnaire method.

DSE 4: COMMUNITY AND PUBLIC HEALTH

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

DSE 4-T

Total Lecture-60

Demography, Society and Community. Basic idea about community, public health issues. Factors affecting Community Health, Direct and Indirect Nutritional Assessment of Human Individual and Community (Steps- Diet History, Nutritional Anthropometry, Dietary Survey, Clinical Examinations, Biochemical and Radiological assessment, Mortality rates, and Morbidity rates). Malnutrition in a community, over nutrition and possible remedial measures. Diet management of obese, diabetic, hypertensive individuals and athletes. Iron and iodine deficiency.

Population problem – principles and methods of family planning. Problem of infertility and Assisted Reproductive Technologies. PCM - Marasmus, Kwashiorkor, Marasmic Kwashiorkor, endemic goiter, nutritional anemias, rickets, osteomalacia, xerophthalmia, Pellagra, dental caries, beriberi and their social implications. Principles and social importance of immunization against diseases. Etiology, epidemiology and prevention – Communicable diseases: Cholera, Malaria, Swine flu, Measles, Pox, Tuberculosis,

Japanese Encephalitis, Rabies, Dengue, Poliomyelitis, Hepatitis and AIDS; Non-communicable diseases – Hypertension and Obesity.

Nutritional Deficiencies in pregnancy and remedial measures. Dietary Management for cardiac heart disease, Diabetes mellitus. Diets of Renal Disorders, Obesity and Cancer.

Composition, functions and uses of ORS.

Vit A Prophylaxis Programme, Anemia Prophylaxis Programme, ICDS, Mid Day Meal Programme.

Human Breast milk: Composition, its requirement and benefits. Colostrum.

DSE 4-P

Calculation of Body Surface Area (using nomogram), Body Mass Index and Ponderal Index from anthropometric measurements.

Diet Survey: Nutritional assessment as per ICMR specification (Steps- Introduction, Diet History, Methodology, Dietary Survey, Clinical Examinations, Remarks, Recommendation and Conclusion). Report should be hand written. Each student has to prepare and submit the report preferably on his/her own family.

DSE-C(One course in Semester VI)

DSE 5: WORK, EXERCISE AND SPORTS PHYSIOLOGY

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

DSE 5-T

Total Lecture-60

Introduction to work physiology

Definitions in work and exercise Physiology. Fundamental concepts of work, work characteristics, work cycle and work pauses. Different categories of work. Different approaches to describe work and work load.

Physiological basis of work

Physiology of muscle action. Physical work load; Static and dynamic work. Physiological responses to static and dynamic work. Relationship between oxygen consumption and heart rate. Effect of heat stress on physiological responses to work load.

Work load assessment

Physiological assessment of work load, work load classification, cardiovascular and respiratory indices for evaluating work load. acceptable work load.

Work Organization

Fundamental concept of work organization. Principles of reducing stress from physical work load

Exercise and Physical fitness

Exercise, physical activity and physical fitness. Benefits of exercise. Components of fitness and their evaluation

Physical Working Capacity

Concept of maximal physical working capacity VO_2 max, and its estimation by different methods. Factors affecting VO_2 max. Step test, bicycle ergometry and treadmill exercise for assessment of Physical working capacity.

Bioenergetics

Work power and energy, sources of energy. Aerobic and anaerobic capacity, EPOC, lactate threshold and lactate tolerance and their limitations. Determination of energy cost by direct and indirect methods. Athletic performance based on aerobic capacity and O_2 debt.

Training Principles

Training principles, different training methods. Training principles for different sports activities. Over training and detraining and their physiological effects. Ergogenic aids.

Body composition

Determination of Physical growth status. Methodologies for body composition analysis.

DSE 5-P

Determination of BMI, BSA, PI, waist hip ratio, body fat percentage and body type. Determination of V_{O_2} max by Queen's College Test and physical fitness by modified Harvard step test. Determination of agility, flexibility and anaerobic power by shuttle run, sit and reach and vertical jump test. Recording of heart rate and blood pressure during static and dynamic work, determination of workload from heart rate and cardiac indices and classification of work load.

DSE 6: ADVANCED MOLECULAR BIOLOGY

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

DSE 6-T

Total Lecture-60

Repetitive DNA, interrupted genes, gene families, transposons. Control of gene expression – attenuation and antitermination, Operon - trp, arabinose, DNA methylation, (DCM, DAM). Post-transcriptional modifications, cap, poly A tail splicing, RNA editing. Role of chromatin in gene expression and gene silencing. Cell-cell communication and quorum sensing in bacteria. Molecular basis of apoptosis in brief. Protein sequencing methods, detection of post translation modification of proteins. DNA sequencing methods. Molecular markers in genome analysis. Methods for analysis of gene expression at RNA and protein level, large scale expression, such as Micro array based techniques. RFLP, RAPD and AFLP techniques. Gene Knockout. Point mutations and deletions. Methods for detection of molecules in living cells, in situ localization by techniques such as FISH and GISH. Genomic medicine. Genetic counselling. Outline of ChIP technique. Fundamentals of nanoscience: The nanoscale dimension and paradigm. Definition of a Nano system, Example- bone minerals and silk. Engineered Nanostructures—Carbon nanotubes, Gold and Silver nanoparticles. Bionanomaterials – Self-assembly in bio nanostructures, e.g., virus self-assembly. Nanomotors- Ribosomes and mammalian myosin. Applications of Nanomaterials in Biology-- Biochemical sensor, Labelling and cellular imaging, Cancer treatment and Regenerative Medicine.

DSE 6-P

SDS-PAGE of proteins. Isolation of DNA from animal cells. Estimation of RNA by Orcinol method .

DSE-D(One course in Semester VI)

DSE 7: CHRONOBIOLOGY AND STRESS PHYSIOLOGY

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

DSE 7-T

Total Lecture-60

Different types of physiological rhythms – ultradian, circadian, infradian. Different zeitgebers and their relation with circadian clock. Hormonal biorhythms and their significance: adrenocortical, pineal and prolactin. Neural basis of biological clock and role of suprachiasmatic nuclei. Sleep-wakefulness cycle. Body temperature rhythm. Time keeping genes. Jet-lag and shift work. Stress : Physical and Emotional Stressors. General Adaptation Syndrome. Role of Hypothalamic-Pituitary-Adrenal Axis and Sympathoadrenal Medullary Axes in coping stress. Effects of chronic stress: Immunological, Cardiovascular Disease, Emotional. Heat disorders and its preventive measures. Effects of hypobaric and

hyperbaric environment. Caisson disease. Preventive measures for hypobaric and hyperbaric effects. Oxidative stress-Formation of Reactive Oxygen Species and the role of Catalase, Superoxide Dismutase, Glutathione Peroxidase and Glutathione Reductase in combating oxidative stress – role of vitamins.

DSE 7-P

Project/Field study Report: Performed in a group and maximum 8 students will be in a group. (Field survey report should be prepared on health related issues).

DSE 8: TOXICOLOGY AND PHARMACOLOGY

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

DSE 8-T

Total Lecture-60

Toxins and Toxicology Factors Affecting toxicity. LD₅₀, LOD₅₀, ED₅₀, NOEL, LOEL. Concepts of Biomagnification and Bioconcentration. The importance of pharmacology in the study of physiological processes. Definition of drug, agonist and antagonist. Drug delivery Drug reactivity. Pharmacokinetics : Drug-receptor interaction, Desensitization of receptors, Absorption, Distribution, Permeation, Elimination, Clearance, Half-life. Pharmacodynamics: dose-response curves. Beneficial versus toxic effects of drugs. Drug biotransformation. Bioavailability. Drug accumulation. Therapeutic index. Anaesthetics : types and mechanism of action of general anaesthetics. Sedatives - hypnotics: benzodiazepine, zolpidem. Diuretics - Carbonic anhydrase inhibitor, loop diuretic, potassium sparing and osmotic diuretics. Neuromuscular blockers: Tubocurarine and succinyl choline. Organ system effects and mechanism of action of adrenoceptor agonists and antagonists: *Adrenergic stimulants*: Amphetamine and ephedrine. α - adrenergic stimulants – Methoxamine and clonidine. β - adrenergic stimulants – Metaproterenol and salbutamol.

Adrenergic antagonists: Labetalol. α - adrenergic blockers – Phenoxybenzamine and phentolamine. β - adrenergic blockers – Propranolol and atenolol.

Antianginal drugs: Nitro-glycerine and calcium-channel blocker – Nifedipine and verapamil.

DSE 8-P

Project / Field study Report: Performed in a group and maximum 8 students will be in a group. (Field survey report should be prepared on health related issues).

Generic Elective Syllabus

[Interdisciplinary for other department]

Generic Elective (GE) [Any four]

GE-1: Blood, Body fluid, Immunity, and Cardiovascular system

GE-2: Nerve-muscle Physiology, Nervous System, and Sensory Physiology

GE-3: Respiration, Digestion, and Excretion

GE-4: Endocrinology and Reproductive Physiology

GE-5: Work and Sports Physiology and Ergonomics

GE-6: Nutrition, Dietetics and Metabolism

GE 1: BLOOD, BODY FLUID, IMMUNITY, AND CARDIOVASCULAR SYSTEM

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

GE 1-T

Total Lecture-60

A. Blood and Immune System

Blood – Composition and function, blood cell formation and related disorders, Blood groups, Blood transfusion and its hazards, Blood clotting and its disorders, Normal and abnormal haemoglobin.

Immunity-innate and acquired, Antigens, antibody-structure, classification and functions, Cytokines, Phagocytosis, Cytotoxicity, Allergy, Inflammation, Autoimmune diseases – Arthritis, Graves' disease, Myasthenia Graves, Hashimoto's disease, Vaccine toxoids, HIV

B. Cardiovascular system

Structure of heart and blood vessels, Junctional tissues of the heart, Cardiac cycle and heart sounds, Cardiac output – factor affecting, Heart rate – regulation, bradycardia, tachycardia, Blood pressure - regulation, hypertension and hypotension, Atherosclerosis, ECG – principle, normal and abnormalities, Artificial pacemaker, Angina pectoris, Cardiac hypertrophy, rheumatoid arthritis, Angiography.

GE 1-P

TC of WBC, DC of WBC (with Leishman stain), Haemoglobin estimation by haematometer. Preparation of haemin crystal. BT, CT & Blood group.

Measurement of HR. BP: systolic, diastolic, mean arterial blood pressure, pulse pressure by Riva-Royce mercury manometer

GE 2: NERVE-MUSCLE PHYSIOLOGY, NERVOUS SYSTEM, AND SENSORY PHYSIOLOGY

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

GE 2-T

Total Lecture-60

A. Nerve-muscle Physiology

Structure of neurons. Origin and propagation of nerve impulse. Velocity of impulse in different types of nerve fibre. Properties of nerve fibres: 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 fibres. Myelination.

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. Single-unit and multi-unit smooth muscle.

B. 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, kinaesthetic, 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.

C. Sensory Physiology

Olfaction and Gustation: Structure of sensory organ, neural pathway of olfactory and gustatory sensation. Mechanism of olfactory and gustatory sensation. Olfactory and gustatory adaptation. After-taste.

Audition: Structure of ear, auditory pathway, mechanism of hearing.

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. Elementary idea of colour vision and colour blindness.

GE 2-P

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. Demonstration: Use of kymograph, induction coil and mercury key. Recording of simple muscle curve with sciatic-

gastrocnemius muscle preparation of toad. Exploration of conductive and perceptive deafness by tuning fork method. Determination of visual acuity by Snellen's chart / Landolt's C chart. Determination of colour blindness by Ishihara chart.

GE 3: RESPIRATION, DIGESTION, ANDEXCRETION

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

GE 3-T

Total Lecture-60

A. Respiration

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.

B. Digestion

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.

C. Excretion

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 3-P

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

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

Identification of abnormal constituents of urine - glucose, proteins, acetone, blood, bile salts.

GE 4: ENDOCRINOLOGY AND REPRODUCTIVE PHYSIOLOGY

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

GE 4-T

Total Lecture-60

A. 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 (T4T3). 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.

B. 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.

GE 4-P

Principles of fixation and staining, Staining and identification of fixed endocrine glands and ovarian tissue. Study and identification of stained sections of different mammalian tissues and organs: Oesophagus, 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. Pregnancy Test (strip method).

GE 5: WORK AND SPORTS PHYSIOLOGY AND ERGONOMICS

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

GE 5-T

Total Lecture-60

A. Work and Sports Physiology

Physical work-definition and units of measurements. Concepts and classification of physiological work - static, dynamic, positive, negative and isokinetic work. Difference between work and sports. Energetics of work - source of energy- aerobic and anaerobic metabolism. Cardiovascular and respiratory responses during graded work. Aerobic and anaerobic capacity. Maximal aerobic power, factors affecting and methods of measurement. Concept of excess post-exercise oxygen consumption. Concept of fatigue. Tests for physical work capacity - Measurement with bicycle ergometer, tread mill and Harvard step test. Basic concepts of Sports Psychology, Role of sports in emotion and social factors. Elementary idea of ergogenic aids. Physical training - general principles and different methods. Nutrition in sports - nutrients and calorie requirements for different kinds of sports.

B. Ergonomics

Basic concepts of ergonomics and its application in industry to increase individual and group productivity. Work-rest cycle. Industrial safety, Occupational hazards- Physical Bio-chemical hazards. Occupational diseases - Silicosis, Asbestosis, Farmer's lung. Anthropometry -common instruments for anthropometric measurements. Application of anthropometry in nutrition and ergonomics.

GE 5-P

Anthropometric parameters: Weight, stature, eye height, shoulder height, elbow height, biacromion breadth, head breadth, head circumference and neck circumference. Mid upper arm circumference, chest circumference, waist circumference, hip circumference, waist hip ratio, BMI, BSA.

Measurement of systolic and diastolic blood pressure at rest and after exercise by Sphygmomanometer.

Determination of PFI of an individual by Harvard Step Test and graphical plotting of changes in pulse and breathing rate during recovery period. Determination of VO₂ max by Queen's College method. Spirometric measurement of vital capacity. Determination of hand reaction time.

GE 6: NUTRITION, DIETETICS AND METABOLISM

[TOTAL CREDITS: 6 (THEORY-4, PRACTICAL-2)]

GE 6-T

Total Lecture-60

A. Nutrition and Dietetics

Basic constitution of food and their nutritional significance. Vitamins: definition, classification, function, deficiency symptoms and daily requirements, hypervitaminosis. Mineral metabolism: Ca, Fe, P. BMR: definition, factors affecting, determination by Benedict Roth apparatus. RQ: definition, factors affecting, significance. Biological value of proteins, essential & non essential amino acids, N_2 equilibrium, minimum protein requirement. Positive and negative N_2 balance. SDA - definition & importance.

B. Metabolism

Glycolysis, TCA cycle, Importance of Glycogenesis, Glycogenolysis and Gluconeogenesis. Beta oxidation of saturated fatty acid. Importance of Ketone bodies . Deamination & Transamination. Formation of urea.

GE 6-P

Qualitative tests for identification of lactic acid, HCl, uric acid, albumin, gelatin, peptone, starch, dextrin, glucose, fructose, lactose, sucrose, maltose, acetone, Glycerol, bile salts, urea.

Quantitative estimation of amino nitrogen by Sorensen's formol titration method. Quantitative estimation of glucose, sucrose by Benedict's method. Estimation of lactose from milk by Benedict's method. Estimation of chloride by Mohr's Method.

Report should be as per ICMR specification. Report should be hand written. Each student has to prepare and submit the report on his/her own family.

RECOMMENDED BOOKS FOR PHYSIOLOGY COURSE

(The latest edition available should be used for all books)

TEXT BOOKS:

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. N
3. Human Physiology, From Cells to Systems Lauralee Sherwood, Brooks/Cole. D I T I
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.VanBruggen, 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.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 WM. Copenhaver; The Williams and Wilkins Company.

17. Human Physiology, by R F.Schmidt& G. Thews, Springer-Verlag.
18. Core Text Book of Neuro-Anatomy, by M.B. Carpenter; The Williams and Wilkins Company.
19. The Human Nervous System, by Charles Nobach, Mc Graw Hill Book Co.
20. The Human Nervous System. by M.L.Barr& I.A. Kierman, Harper & Row.
21. Essential Immunology, by I.M. Roitt, Blackwell Scientific Publications.
22. Cellular & Molecular Biology, by E. D. P. De Robertis& E. M. F. De Robertis, Lea &Febiger.
23. Principles of Genetics, Sixth edition, D. Peter Snustad, Michael J. Simmons John Wiley & Sons, Inc.
24. Molecular Biology of the Gene, by J.D. Watson. H.H. Nancy & others; Pearson education.
25. Molecular Biology of the Cell, by B. Alberts and others, Garland.
26. Human Physiology, by Rhoades &Pflanzer, Brooks/Cole.
27. Carleton's Histological Techniques, by R.A.B. Drury & E.A. Wallington, Oxford University Press.
28. Medical physiology W. F. Boron and E. L. Boulpsep, Elsevier Saunders
29. Handbook of Experimental Physiology and Biochemistry, by P. V. Chadha; Jaypee Brothers Medical Publishers. .
30. Kuby Immunology, by RA. Goldsby. T.J. Kindt and B.A. Osbome. W H. Freeman and Co.
31. Neurobiology. by G.M. Shepherd, Oxford University Press.
32. Biochemistry, by L. Stryer, WH. Freeman and Co.
33. Molecular Cell Biology, by H. Lodish, D. Baltimore & others, Scientific American Book.
34. Genetics: Analysis of Genes and Genomes, by D.L. Hartl and E. W Jones. Jones &Boolen Publishers.
35. Note Books on Practical Biochemistry, Experimental Physiology and Histology. (published by the Physiological Society of India, Kolkata)
36. Willam's Text Book of Endocrinology by J.D. Wilson and D.W.Foster W.B. Saunders of Co.
37. The Kidney-An outline of Normal and Abnormal Functions by H.E. Dewardeper. ELBS
38. Essential Food and Nutrition. by M. Swaminathan. The Bangalore Printing & Publishing Co. Ltd.
39. Medical Embryology by J. Langman, .Williams& Wilkins.
40. Circadian Rhythms and the Human by D.S. Minors and IM. Wat~rhouse, Wright, PSG.
41. Clinical Gynecologic Endocrinology and Infertility by L, Speroff, R. H. Glass, N. G. Kase, MacMillan
42. Text book of Medical Physiology by G. K. Pal, P. Pal, Ahuja Pub. House.
43. Essential Medical Physiology Edited by L. R. Johnson, Academic Press.
44. Human Anatomy and Physiology by E. Marieb, Pearson Education.
45. Fundamentals of Biochemistry by Jain and Jain, S. Chand and Com.
46. Biochemistry by U. Satyanarayan, Boks and Allied.
47. Lippincott's Illustrated Reviews: Biochemistry by P. C. Champe et al., Lippincott Williams & Wilkins.
48. Biochemistry by Pankaja Naik, Jaypee Brothers.
49. Physiology by J. Bulck et al Lippincott Williams & Wilkins.
50. Text book of Biochemistry by T. M.Devlin, John Wiley Pub.
51. Fundamentals of Biochemistry by Voet, Voet, and Pratt, John Wiley Pub.
52. Cellular and Molecular Immunology A.K Abbas and A. H. Lichtman, Elsevier Saunders.
53. Under Standing Immunology by Peter Wood, Pearson Education.
54. Text Book of Biochemistry and Physiology by G. P. Talwar and L.M. Stivastava, Prentice Hall of India.
55. Chronobiology Edited by J. C. Dunlap, J. J. Loros, P. J. deCoursey, Sinauer Associates Inc. Pub.
56. Text Book of Physiology by G. H. Bell, J. N. Daviclc;on and H. Scarboroughl, ELBS.
57. Physiology of Respiration by J.H. Comroe, Year Book Medical Publishers.
58. Text Book of Physiology. Vols. I & II by H. D. Patton. A. F. Fuchs, B. Hille. A. M. Scher and R. Sleiner, W B. Saunders Co.
59. Concise Medical Physiology by S.K. Chaudhury, New Central Book Agency.
60. Medical Physiology by A.B. S. Mahapatra, Current Books International.
61. Endocrinology, Vols. I, II and III by L.a. DeGroot. W.B. Saunders Co.
62. Essentials of Human Embryology by A.K. Das Current Books International.
63. Human Embryology by I.B. Singh, MacMillan India Ltd.
64. The Circadian System of Man by R.A. Wever, springer- verlag.
65. The Clocks That Time Us by M. C. Moore - Ede and others, Harvard University Press.
66. The Physiological Clock: Circadian Rhythms and Biological Chronometry by E. Bunning, SpringerVerlag.
67. Theory and Practice of Histological Techniques by J. D. Bancroft & A. Stevens, Churchill Living stone.
68. Practical Biochemistry in Medicine by Srinivas Rao, Academic Publishers.
69. The Physiology of Reproduction, Vols, I & II, by E. Knobil and J.D. Neil, Raven Press.
70. Introduction to Biotechnology by W. J. Thieman and M. A. Palladino, Pearson Education.
71. Microbiology by G. J Tortora, B. R. Funke, C. I. Case, Pearson Education.
72. A Text Book of Basic and Applied Microbiology, K. R. Aneja, P. Jain, R Aneja New Age Inc. Pub.
73. Brock Biology of Microorganism by M. T. Madigan et al., Prentice Hall Inc.

74. Microbiology by J. L. Slonczewski and J. W. Foster, W. W Norton
75. Fundamentals of Biochemistry by A. C Deb, New Central Book Agency.
76. Biotechnology By R. C. Dubey; S, Chand Pub.
77. Essentials of Molecular Biology by V. Malathi, Pearson Education.
78. Biostatistics by P. Mariappan, Pearson Education.
79. Genetics and Genomics by Waseem Ahmad (Faridi), Pearson Education.
80. Text Book of Preventive and Social Medicine, M. C. Gupta and B. K. Mahajan, Jaypee Brothers. 81. Microbial Physiology, A. G. Moat, J. W. Foster, M. P. Spector, John Wiley Pub.
82. Essentials of Medical Pharmacology by K. D. Tripathi, Jaypee Brothers.
83. Environmental Pollution by S. S. Purohit and A. K. Agrawal, Agrobios India.
84. Genera and Applied Toxicology, B. BallanTye, T. Marrs, P. Turner, Macmillan Pub.
85. Environmental Toxicants Edited by M Lippmann, John Wiley Pub.
86. Basic and Clinical Endocrinology Edited by F. S. Greenspan and D. G. Gardner, Lange Medical Book.
87. A Text Book Biophysics by R. N. Roy, New Central Book Agency.
88. Handbook of Biomedical Instrumentation by R. S. Khandpur, Tata McGraw-Hill Pub.
89. Cel Biology by C. B. Power, Himalaya Publishing House.
90. Neuroscience, M. F. Bear, B. w. Connors, M. A. Paradiso, Lippincott Williams & Wilkins.
91. Genetics by L. H. Hartwell et al., McGraw-Hill Pub.
92. Cell and Molecular Biology by G. Karp, John Wiley Pub.
93. Fundamentals of Biostatistics by V. B. Rastogi, Ane Books
94. Exercise Physiology by S. K. Powers, E. T. Howley, McGraw-Hill Pub.
95. The Physiological Basis of Physical Education and Athletics by E.L. Fox and D.K. Mathews. Saunders College Publishing.
96. Statistics in Biology and Psychology by D. Das..Acadernic Publishers.
97. Pesticides by P.K. Gupta, Interpret.
98. Environmental Chemistry by A. K. De, New Age Inc.
99. Exercise Physiology - Energy, Nutrition and Human Perfonnance by W.D. McArdle. F. Katch and Y.L. Katch. Williams and Wilkins.
100. Essentials of Exercise Physiology by L.G. Shaver, Surjeet Publications.
101. Text Book of Environmental Physiology by C. Edger Folk Jr., Lea and Febiger.
102. The Pharmacological Basis of Therapeutics by L.S. Goodman and A. Gihnan. Macmillan Publishing Co.
103. Quintessence of Medical Pharmacology.S. K. Chaudhuri. New Central Book Agency.
104. Pharmacology in Medicine by S.N. Praclhan. R.P. Maickel and S.N. Dutta. S.P. Press International Inc.
105. Microbiology. by M. J. Pelczer& Others; Tata McGraw Hill Publishing Co Ltd.
106. Biomedical Instrumentation & Measurements, by L. Cromwell, Fj. Weibell& E.A. Pfeiffer; PrenticeHall of India Pvt Ltd.
107. Molecular Biology and Biotechnology by R. A Meyers, VCH publishers
108. Recombinant DNA and Biotechnology by H. Kreuzer and A. Massey, ASM press.
109. Park's Text Book of Preventive and Social Medicine by K.Park, BanarsidasBhanot Publishers
110. Text Book of Work Physiology by P.O. Astrand and K. Rodahl. McGraw-Hili Book Co.
111. Human Factors in Engineering and Design by E.O. McConnick and M. Sanders. Tata McGraw-Hill.
112. Energy. Work and Leisure by J. Y.G.A. Durinand, R. Passmore. Heinemann Educational Books.
113. Sports Physiology by E.L. Fox. Saunders College Publishing. Holt-Saunders.
114. The Principles and Practice of Human Physiology by O. G. Edholm and others AcademicPress.
115. Pharmacology by M. Das, Books and Allied (P) Ltd:
116. Basic and Clinical Pharmacology by E.G. Katzung, Appleton and Lange Pub.
117. An Introduction to Biological Rhythms by John D. Palmer, Academic Press.
118. Medical Statistics by B.K. Mahajan. Jaypee Brothers, Medical Publishers Pvt. Ltd.
119. Statistical Methods by G. W. Snedecor and W.G. Cochnin, Oxford &ffih Publishing Co Pvt. Ltd.
120. A text Book of Practical Physiology, C. L. Ghai, Jaypee Brothers.
121. Modern Human Physiology, B. K. Chakraborty, H. N. Ghosh, and S. N. Sahana, The New Book Stall.
122. Medical Physiology, A. K. Das, Books and Allied (P) Ltd.
123. The elements of Immunology, F. H. Khan, Pearson Education.
124. The world of The Cell, Becker, Pearson Education.
125. Physiology of Sports and Exercise, J.H. Wilmore, D. L. Costill, W. L. Kenney, Pub. Human Kinetics.
126. Crash Course of Physiology, Shahid and Nunhuck, Mosby Pub.
127. Introduction to Clinical Nutrition by V. Sardesai, CRC Press.
128. Endocrinology by Hadley, Pearson Education.
129. Introduction to Biochemistry and Metabolism by Anandhi, Pearson Education.
130. Modern Experimental Biochemistry by Boyer, Pearson Education.

131. Cell Organization and Function by Shakir Ali, Pearson Education.
132. Fundamentals of Immunology by Sumitha, Pearson Education.
133. IPR, Biosafety and Bioethics, Goel and Parashar, Pearson Education.
134. Practical Physiological Chemistry by P. B. Hawk, B. L. Oser, W. H. Summerson, Mc.Graw-Hill Publishing Co.
135. Basic Concept in Immunology, A. Hati, S. Roy, B. Saha, K. Bharati, Allied Book Agency, Kolkata.
136. Nutritive Value of Indian Foods, by C. Gopalan and other, NIN, Hydreabad.
137. Text book of Microbiology, by R. Anantanarayan and C. K. JoyramPaniker, Oriennt Longman.
138. Food Microbiology by W.C Frazier and D.C Westhoff. Tata McGraw Hill Publisher.
139. Text book of Preventive and Social Medicine by M.C Gupta and B.K Mahajan, Jaypee Bothers.
140. Recombinant DNA by J.D Watson, M. Gilman, J. witkowski and M. Zoller, Scientific American Books.
141. Biotechnology by S. S. purohit; Agrobios , India.
142. Lippincott's Illustrated Review of Physiology, by R. R. Preston; Lippincott Williams and Wilkins.
143. Computer in Biology by Prof. P. C. Dhara. Academic Publication, Kolkata.
144. Vander's Human Physiology by E. P. Widmaier et al., McGraw Hill Publication.