



Tripura University

(A Central University)

Suryamaninagar

West Tripura

Syllabus for
Four Years Undergraduate Programme
Subject: Human Physiology
(As per NEP-2020)

Year - 2023



Tripura University
(A Central University)

Course Structure of Human Physiology (UG Programme)

As per NEP-2020 under Tripura University

HUMAN PHYSIOLOGY MAJOR

Year	Semester	Paper	Credit	Mark	Unit - I	Unit - II	Unit-III	Unit-IV
1 st	1 st HP-101C	Paper-1 Theory	4	100 (IA=40 + ESE=60)	History of Physiology & Medicine	Contribution of Indian scientists in the field of Physiology and allied health sciences	Structural and functional basis of Human Body-I	Structural and functional basis of Human Body- II
	HP-102C	Paper-2A Theory	2	60 (IA=24 + ESE=36)	Biophysics and Physicochemical Principles	Chemistry of Bio molecules, structure and classification of macromolecules, protein separation		
		Paper-2B Practical	2	40 (IA=16+ESE=24)	Based on Theory paper 1 & 2A			
	2 nd HP-103C	Paper-3 Theory	4	100 (IA=40 + ESE=60)	Cardiovascular System-I	Cardiovascular System-II	Respiratory System-I	Respiratory System-II
	HP-104C	Paper-4A Theory	2	60 (IA=24 + ESE=36)	Physiology of Blood and body fluids-I	Physiology of Blood and body fluids-II		
		Paper-4B Practical	2	40 (IA=16+ESE=24)	Based on Theory paper 3 & 4A			
2 nd	3 rd HP-201C	Paper-5 Theory	4	100 (IA=40 + ESE=60)	Enzyme classification and kinetics-I	Enzyme classification and kinetics-II	Digestion & absorption-I	Digestion & absorption-II
	HP-202C	Paper-6A Theory	2	60 (IA=24 + ESE=36)	Excretory Physiology	Skin and body temperature regulation		
		Paper 6B Practical	2	40 (IA=16+ESE=24)	Based on theory paper 5 & 6A			
	4 th HP- 203C	Paper-7 Theory	4	100 (IA=40 + ESE=60)	Endocrinology-I	Endocrinology-II	Reproductive Physiology -I	Reproductive Physiology-II
	HP-204C	Paper-8A Theory	2	60 (IA=24 + ESE=36)	Nerve muscle Physiology-I	Nerve muscle Physiology-II		
		Paper 8B Practical	2	40 (IA=16+ESE=24)	Based on theory paper 7 & 8A			

3 rd	5 th HP-301C	Paper-9 Theory	4	100 (IA=40 + ESE=60)	Molecular Biology-I	Molecular Biology-II	Human Genetics-I	Human Genetics-II
	HP-302C	Paper-10A Theory	2	60 (IA=24 + ESE=36)	Cell Signaling	Cell cycle and Apoptosis		
		Paper 10B Practical	2	40 (IA=16+ESE=24)	Based on theory paper 9 & 10A			
	HP-303C	Paper-11 Theory	4	100 (IA=40 + ESE=60)	Immunolo gy-I	Immunology-II	Immunolo gy-III	Immunology-IV
	HP-304C	Paper-12A Theory	2	60 (IA=24 + ESE=36)	Molecular Physiologi cal basis of Cancer-I	Molecular Physiological basis of Cancer-II		
		Paper 12B Practicals	2	40 (IA=16+ESE=24)	Based on theory paper 11 & 12A			
	6 th HP-305C	Paper-13 Theory	4	100 (IA=40 + ESE=60)	Nervous System-I	Nervous System-II	Nervous System-III	Nervous System-IV
	HP-306C	Paper-14A Theory	2	60 (IA=24 + ESE=36)	Special senses-I	Special senses-II		
		Paper 14B Practical	2	40 (IA=16+ESE=24)	Based on theory papers 13 & 14A			
	HP-307C	Paper-15 Theory	4	100 (IA=40 + ESE=60)	Exercise & Sports Physiolog y-I	Exercise & Sports Physiology-II	Exercise & Sports Physiology -III	Yoga
	HP-308C	Paper-16A Theory	2	60 (IA=24 + ESE=36)	Work Physiolog y	Ergonomics and Occupational Health		
		Paper 16B Practical	2	40 (IA=16+ESE=24)	Based on theory papers 15 & 16A			
4 th	7 th HP-401C	Paper-17 Theory	4	100 (IA=40 + ESE=60)	Metabolic Biochemis try -I	Metabolic Biochemistry -II	Metabolic Biochemist ry -III	Metabolic Biochemistry -IV
	HP-402C	Paper-18A Theory	2	60 (IA=24 + ESE=36)	Nutrition	Dietetics		
		Paper 18B Practical	2	40 (IA=16+ESE=24)	Based on theory papers 17 & 18A			
	HP-403C	Paper-19 Theory	4	100 (IA=40 + ESE=60)	Embryolo gy	Development-al Biology-I	Developm ental Biology-II	Stress Physiology
	HP-404C	Paper-20A Theory	2	60 (IA=24 + ESE=36)	Neuroche mistry	Behavioral Physiology, Higher brain functions & Chronobiology		
		Paper-20B Practicals	2	40 (IA=16+ESE=24)	Based on theory papers 19 & 20A			
	8 th HP-405C	Paper-21 Theory	4	100 (IA=40 + ESE=60)	Medical Microbiol ogy-I	Medical Microbiology-II	Medical Microbiolo gy-III	Medical Microbiology-IV

	HP-406C	Paper-22A Theory	2	60 (IA=24 + ESE=36)	Environm ental Physiolog y	Public Health issues		
		Paper-22B Practical	2	40 (IA=16+ESE=24)	Based on theory papers 21 & 22A			
	HP-407C	Paper-23 Theory	4	100 (IA=40 + ESE=60)	Molecular & Cell Biological Technique s-I	Molecular & Cell Biological Techniques-II	Molecular & Cell Biological Technique s-III	Immunological Techniques
	HP-408C	Paper-24A Theory	2	60 (IA=24 + ESE=36)	Biostatisti cs	Research Methodology & Ethical issues in Biomedical Research		
		Paper-24B Practicals	2	40 (IA=16+ESE=24)	Based on theory papers 23 & 24A			

DETAILED COURSE CONTENT
OF
HUMAN PHYSIOLOGY MAJOR

1ST YEAR

SEMESTER-I

HP-101C

Paper- 1 (Theory)

Total Mark = 100 (IA = 40 + ESE = 60) Credit = 04

Unit-I: History of Physiology & Medicine and Contribution of Indian scientists in the field of Physiology and allied health sciences

1. A history of Physiology and Medicine.
2. Contribution of India in ancient time - Charaka; Sushruta; Patanjali;
3. Landmark physiological experiments and discoveries.
4. Contribution of modern Indian scientists in physiology - U.N. Brahmachari, S.C. Mahalanobis, J.B.S. Haldane, A.S Paintal.

Unit-II: Structural and functional basis of Human Body-I

1. Cell theory, structure of eucaryotic cell, different human tissue types.
2. Structure and function of: Biomembrane- structure, composition and function, Use of Intracellular Vesicles to Replenish Cellular Membranes, Cell junction, transport through membrane,
3. Structure and function of Endoplasmic reticulum, Golgi body, Mitochondria,
4. Structure and function of Nucleus, Ribosomes, Cell inclusions.

Unit-III: Structural and functional basis of Human Body-II

1. Structure and function of Lysosomes, Peroxisomes,
2. Structure and function of Cytoskeletal system, Locomotion of Cells - ameboid locomotion and ciliary movement- cells in the body showing these movements
3. Functional Systems of the cell, endocytosis-phagocytosis and pinocytosis, mechanism, Digestion of Pinocytotic and Phagocytic Foreign Substances Inside the Cell,
4. Regression of Tissues and Autolysis of Cells,

Unit-IV: Structural and functional basis of Human Body-III

1. Structural and functional basis of different human body organ and organ systems,
2. Musculoskeletal system,
3. Homeostasis and its control systems,
4. Anthropometric landmarks.

Paper- 2A (Theory)

Total Mark = 60 (IA = 24 + ESE = 36) Credit = 02

HP-102C

Unit-I: Biophysics and Physicochemical Principles

1. Diffusion, osmosis, surface tension & viscosity-definition and physiological applications.
2. Properties of water, pH and Buffer-definition, example of buffers, buffering properties of

- amino acids, zwitterion, pKa value, weak chemical bonds, biological significance
- 3. Henderson-Hasselbalch equation, mathematical problems on Ph and buffer.
- 4. Gibbs-Donnan membrane equilibrium its biological application and relation with osmotic pressure and pH.
- 5. Colloids-Classification, properties optical and electrical, Physiological importance of Colloids.

Unit-II: Chemistry of Biomolecules

- 1. Carbohydrates-Definition and, Classification, Monosaccharides-classification, structure, stereoisomerism, optical isomerism, optical activity, epimerism.
- 2. Cyclic structure-pyranose and furanose forms, anomerism, mutarotation and its mechanism, Polysaccharides-Starch, glycogen, cellulose, chitin, dextrin- structural comparison.
- 3. Lipids - Definition and Classification. Fatty acids-Classification, and structure. Phospholipids and glycolipids-classification and physiological significance. Mono and poly unsaturated fatty acids and their physiological significance.
- 4. Sterols-Chemical nature, structure, classification and physiological importance.
- 5. Amino acids-Classifications. Peptide and Protein: Primary, secondary (alpha helix, beta-sheet and globular structure), tertiary, quaternary structure of proteins.
- 6. Protein purification and separation methods.

Paper-2B (Practical)

HP-102C

Total Mark = 40 (IA = 16 + ESE = 24) Credit = 02

CONTENTS:

- 1. Study of Models/Charts of different body organ systems & organs –Anatomical position, Structure & Functions.
- 2. Study of Body Anthropometry-Stature, weight, sitting height, shoulder height(standing), Elbow height (standing), Hip height (standing), hand length, shoulder elbow length, leg length, shoulder breadth (biacromial), Arm reach from wall (Arm span) Knee to Knee Breadth, Elbow to elbow breadth, Head circumference, Shoulder circumference, Chest circumference, waist circumference, hip circumference. Calculation of BMI, BSA, WHR, Head and Chest circumference ratio.
- 3. Qualitative identification of physiologically important substances –HCL, Lactic acid, Uric acid, Albumin, Peptone, Starch, Dextrin, Glucose, Fructose, Lactose, Maltose, Sucrose, Bile salt, Acetone, Glycerol, urea.
- 4. **Laboratory Records:** Student must get the laboratory note books duly signed by the respective teacher during practical classes.
- 5. **Viva voce:** Questions based on theory and practical syllabus of 1st semester.

SEMESTER-II
HP-201C
Paper-3 (Theory)
Total Mark = 100 (IA = 40 + ESE = 60) Credit = 04

Unit-I (Cardiovascular System-I)

1. Anatomy of the heart. Properties of cardiac muscle. Origin and propagation of cardiac impulse. Heart Block.
2. Cardiac cycle-Pressure and volume changes. Heart sounds. Murmurs.
3. Cardiac output-Measurement by application of Fick's principle & factors affecting. Starling's law of heart.
4. Electrocardiography- Principles of Electrocardiography, Normal electrocardiogram, different waves, intervals and segments; different electrocardiographic lead systems. Cardiac Arrhythmias. The pulse- Arterial and venous. Hemodynamic of blood flow.

Unit-II (Cardiovascular System-II)

1. Innervation of the heart and blood vessels, cardiac and vasomotor reflexes.
2. Coronary Circulation. Coronary artery disease- Atherosclerosis.
3. Blood vessels-types, structure. Hemodynamics: velocity of blood flow, nature of blood flow, Flow-Pressure- Resistance relationship.
4. Blood pressure-regulation with special reference to sino-aortic mechanism. Its controlling factors.
5. Immediate and delayed effects of haemorrhage.

Unit-III (Respiratory System-I)

1. Anatomy and histology of the lung and airways.
2. Mechanics of breathing: Role of respiratory muscles, Compliance of lungs and chest wall, pressure-volume relationships, alveolar surface tension and surfactant. Spirometry: Lung volumes and capacities. Dead space.
3. Pulmonary Circulation.
4. Ventilation-perfusion ratio, Transport of gases (O₂ and CO₂) in body: Partial pressure and composition of normal atmospheric gases in inspired, expired, alveolar airs and blood.

Unit-IV (Respiratory System-II)

1. Oxygen dissociation curve of haemoglobin – factors affecting. Carbon dioxide dissociation curve.
2. Regulation of respiration -- neural and chemical, respiratory centers, chemoreceptors, baroreceptors, pulmonary receptors.
3. Disorders of Breathing: Hypoxia: Types & effects. Asphyxia, Cyanosis, Periodic breathing, Apnoea, Asthma, Emphysema.
4. High altitude pulmonary oedema (HAPO). Oxygen therapy. Decompression sickness, caisson's disease.

Paper- 4A (Theory)

HP-202C

Total Mark = 60 (IA = 24 + ESE = 36) Credit = 02

Unit-I (Physiology of Blood and body fluids-I)

1. Bone marrow: Formed elements of blood—origin, formation, functions and fate.
2. Plasma proteins: Origin and functions.
3. Erythropoiesis-factors effecting and leucopoiesis.
4. Haemoglobin-Structure, types. Anaemia.

Unit-II (Physiology of Blood and body fluids-II)

1. Blood volume-factors effecting.
2. Haemostasis-Factors, mechanism, anticoagulants, procoagulants. Disorders of haemostasis -Haemophilia.
3. Blood group-ABO, Rh system and other minor blood group systems. Blood transfusion and its hazards.
4. Lymph and tissue fluids-Formation, circulation, functions and fate.
5. Lymphaticorgans-
Histologicalstructuresandfunctionsoflymphglandandspleen.Spleno
megalycauses andeffects.

Paper-4B (Practical)

HP-202C

Total Mark = 40 (IA = 16 + ESE = 24) Credit = 02

CONTENTS:

1. Haematological experiments: Preparation and staining of blood film with Leishman's stain. Identification of blood cells. Total count of W.B.C and R.B.C. Differential count of W.B.C. Haemoglobin estimation by Sahli's hemoglobinometer. Preparation of haemin crystals.
2. Cardiovascular Physiology Experiments: Determination of Blood pressure in different body posture. Determination of pulse rate.
3. InterpretationofKymographicrecordingofthemovementsofperfusedheartoftoadandtheeffectsof Excess Calcium, acetylcholine and adrenaline on the contraction of heart.
4. Respiratory Human Experiments: Pneumographic recording / demonstration of effects of hyperventilation, breath-holding and talking. Interpretation of lung function tests using Spirometry (Digital) and analysis of the results.
5. Determination of Peak Expiratory Flow Rate
6. **Laboratory Records:** Student must get the laboratory note books duly signed by the respective teacher during practical classes.
7. **Viva voce:** Questions based on theory and practical syllabus of 3rd semester.

2ND YEAR

SEMESTER-III

HP-301C

Paper- 5 (Theory)

Total Mark = 100 (IA = 40 + ESE = 60) Credit = 04

Unit-I (Enzyme classification and kinetics-I)

1. Classification of enzymes
2. Co enzymes and co factors, prosthetic group
3. Models of enzyme action
4. Multi-enzyme system-example, advantages

Unit-II (Enzyme classification and kinetics-II)

1. Enzyme kinetics: Factors affecting enzyme activity.
2. Michaelis-Menten constant (K_m); Lineweaver-Burk plot.
3. Enzyme Inhibition: Type – competitive, non competitive and uncompetitive
4. Feedback and allosteric regulation of enzymes.

Unit-III (Digestion & absorption-I)

1. Anatomy and histology of alimentary tract & digestive glands.
2. Mastication, Deglutition and movements of alimentary canal.
3. Composition, function and regulation of secretion of salivary, gastric, pancreatic and intestinal juice and bile.
4. Formation, secretion and regulation of HCL, concept of hyperacidity, achlorhydria
5. Gastro-intestinal hormones.

Unit-IV (Digestion & absorption-II)

1. Entero-hepatic circulation of bile salt-role of bile indigestion.
2. Digestion and absorption of carbohydrates, proteins and fats.
3. Defecation-mechanism, constipation
4. Basic concept of peptic ulcer, gallstone,
5. Vomiting center and mechanism, anti-vomiting agents and mode of action.

Paper- 6A (Theory)

HP-302C

Total Mark = 60 (IA = 24 + ESE = 36) Credit = 02

Unit-I (Excretory Physiology)

1. Histology, Structural and Anatomy of kidney and nephron. Renal circulation – peculiarities and auto regulation. Glomerular filtration, GFR, measurements, regulation. Juxtaglomerular apparatus.
2. Tubular reabsorption and secretion
3. Formation of hypotonic and hypertonic urine-counter current mechanism.

4. Renal regulation of osmolarity and blood volume, Renal regulation of acid-base balance,
5. Physiology of urinary bladder and micturition. Abnormalities of micturition. Renal function tests. diuretics.

Unit-II (Skin and body temperature regulation)

1. Histology and functions of skin.
2. Skin wounds, classification and phases and mechanisms of wound healing.
3. Sweat glands—structure and composition of sweat, Mechanism of sweat formation, secretion and its regulation. Insensible perspiration.
4. Regulation of body temperature in homeotherms - its physical and physiological processes, roles of neural and hormonal processes.
5. Heat Stress, Pyrexia, hyperthermia and hypothermia.

Paper-6B (Practical)

HP-302C

Total Mark = 40 (IA = 16 + ESE = 24) Credit = 02

CONTENTS:

1. Study and identification of histological slides of digestive system and excretory system.
2. Study of Models for anatomical position and functions of organs of digestive system and excretory system and skin.
3. Urine analysis: Identification of abnormal constituents of urine (albumin, ketone, glucose, bile salt).
4. Assessment of nutritional status by recall method and Diet survey.
5. **Laboratory Records:** Student must get the laboratory note books duly signed by the respective teacher during practical classes.
6. **Viva voce:** Questions based on theory and practical syllabus of 2nd semester.

SEMESTER-IV

Paper-7 (Theory)

HP-401C

Total Mark = 100 (IA = 20 + ESE = 80) Credit = 04

Unit-I (Endocrinology-I)

1. Concept of autocrine, paracrine and endocrine system. Anatomical organization of endocrine glands. Mode of action of hormones, signal transduction and concept of second messenger system. Feedback regulation of hormone action.
2. Hypothalamus and Pituitary-Hypothalamus as a neuroendocrine organ. Hypothalamic releasing factors. Hypothalamo-hypophyseal portal system, Anterior and posterior pituitary- histological structure of the gland.
3. Pituitary hormones, functions and regulation of secretion of hormones.
4. Thyroid and Parathyroid-Histological structure of the glands. Thyroid and parathyroid hormones, chemical nature, mechanism of action, functions and regulation of secretion of the hormones. Calcium-phosphate homeostasis.

Unit-II (Endocrinology-II)

1. Adrenal gland-Histological structure of the gland. Adrenal cortical and medullary hormones, mechanism of action, functions and regulation of secretion of these hormones.
2. Endocrine Pancreas- Histological structure. Hormones of Islet of Langerhans, Insulin, glucagon and other hormones, mechanism of action, functions and regulation of secretion of the hormones.
3. Hormonal control of blood sugar. Diabetes mellitus-types.
4. Gastro-intestinal hormones–Gastrin, Secretin, CCK, somatostatin, ghrelin and GRP-- functions of these hormones.
5. Effect of hypo and hyper secretion of hormones of different endocrine glands.

Unit-III (Reproductive Physiology-I)

1. Anatomical organization of male and female reproductive organs. Primary and accessory sex organs and secondary sex characters.
2. Histology of testis. Blood testis barrier,
3. Endocrine functions of testis. Spermatogenesis and its regulation
4. Hypothalamic control of testicular functions. Cryptorchidism.

Unit-IV (Reproductive Physiology-II)

1. Histology of ovary. Ovarian hormones and their functions.
2. Oogenesis and ovulation. Formation and functions of corpus luteum.
3. Physiology of puberty. Menstrual cycle- ovarian and uterine changes and its hormonal regulation. Onset of menopause and postmenopausal changes. Abnormalities in menstrual cycle.
4. Physiology of lactation and parturition.

Paper-8A (Theory)

HP-402C

Total Mark = 60 (IA = 24 + ESE = 36) Credit = 02

Unit-I (Nerve muscle Physiology-I)

1. Structure, properties and classification of Neurons and Neuroglia.
2. Nerve fibers structure and types. Properties of nerve fibers, modern concept of generation of resting membrane potential, graded potential.
3. Action potential, ionic basis, characteristics of AP, propagation in different types of nerve fibers. Rheobase and chronaxae.
4. Nerve injury-Degeneration and regeneration of nerve fibers, Factors affect Nerve growth.

Unit-II (Nerve muscle Physiology-II)

1. Synapse, structure, classification, properties, Transmission of nerve impulse through synapse, EPSP, IPSP. Neuromuscular Junction, structure, motor unit, motor point, propagation of nerve impulse through the neuro-muscular junction, MEPP, EPP.
2. Receptors, classification, types, properties, mechanism of transduction of stimuli from sensory receptors, Reflex, arc, classification, properties.
3. Muscle: Structural properties of skeletal and smooth muscles,
4. Sarco-tubular system, Mechanism of skeletal and smooth muscle contraction, EC coupling, Rigor-mortis.
5. Properties of skeletal muscle.

Paper-8B (Practical)

HP-402C

Total Mark = 40 (IA = 14 + ESE = 24) Credit = 02

CONTENTS:

1. Study and identification of histological slides of endocrine glands and reproductive system.
2. Study of Models for anatomical position and functions of organs of endocrine glands and reproductive system
3. Staining of skeletal and cardiac muscle by methylene blue.
4. Demonstration on the nerve-muscle preparation and interpretation of kymographic recording of isotonic muscle twitch, effects of temperature, load and two successive stimuli on muscle twitch.
5. Study of Charts on—Spermatogenesis and oogenesis.
6. Study of Charts for identification of—Primary, secondary and mature graffian follicles.
7. Determination of onset of puberty from the velocity growth curve of stature of school children.

3RD YEAR
SEMESTER-V
HP-501C
Paper-9 (Theory)
Total Mark = 100 (IA = 40 + ESE = 60) Credit = 04

Unit-I (Molecular Biology-I)

1. Nucleic acid: Chemical composition of DNA, RNA and DNA structure, detailed account of double stranded DNA, B-DNA, Z-DNA.
2. DNA the genetic material (Experimental proof-Griffith and Harshey and Chase Experiments).
3. Replication: Semi-conservative model of DNA replication.
4. Prokaryotic DNA replication, replication origin, role of primase, DNA polymerases, helicase, topoisomerase, gyrase, ligase, and the mechanism of replication, leading strand and lagging strand synthesis. Functions of DNA polymerases-I, exonuclease activity.
5. Telomere, telomerase and mode of action.

Unit-II (Molecular Biology-II)

1. Transcription: Types of RNA, characteristics of prokaryotic and eukaryotic promoters, Coding region and noncoding region of genes, subunits of prokaryotic RNA polymerase and their functions, eukaryotic RNA polymerase
2. Transcription, initiation, elongation and termination (rho dependent and rho independent mechanism).
3. Post-transcriptional processing of mRNA – capping, poly A tailing and splicing.
4. Translation: t RNA structure, Genetic code, degeneracy of genetic code, Wobble hypothesis. Mechanism of translation.
5. Regulation genes expression and operon concept, regulation of Lac operon and Tryptophan operon.

Unit-III (Human Genetics-I)

1. Chromosomal organization – chromosomal packaging, role of histones and other proteins.
2. Concept of gene and genome sizes. Gene structure: structural organization of prokaryotic and eukaryotic genes, repetitive DNA, DNA fingerprint
3. Regulatory elements of eukaryotic genes, (proximal or internal including promoter, operator, activator and enhancers).
4. Eukaryotic transcription factors – structure and function- concise account of helix turn helix proteins, helix loop helix proteins, helix turn beta, zinc finger protein; mode of action.
5. Epigenetic modifications – DNA and chromosomal proteins.-methylation acetylation, micro RNA .Unit-IV (Human Genetics-II)

1. Mendelian genetics- Mendel's experiments, monohybrid crosses, principles of dominance, dihybrid crosses, incomplete dominance, co-dominance. Gene

- polymorphism, Pedigree analysis,
2. Karyotyping, polyploidy, aneuploidy
 3. Inborn errors of biochemical metabolism Inborn errors of carbohydrate metabolism: glycogen storage disease, essential pentosuria, fructosuria, galactosemia, inborn errors of protein and amino acid metabolism: phenyl ketonuria, alpeptonuria, albinism, cystinuria, hypertyrosinemias, homocystinuria, inborn errors of lipid metabolism: Gaucher's disease, Fabry's disease, Tay Sachs's disease, Niemann pick disease Human Genetical Disorders –autosomal (Phenylketonuria, albinism), sex-linked (haemophilia, red green colour blindness), diseases with abnormal chromosome numbers and examples.
 4. Hardy Wein-berg principle and population genetics. Genetic drift and genetic shift.
 5. Monogenic and polygenic disorders.

Paper-10A (Theory)

HP-502C

Total Mark = 60 (IA = 24+ ESE = 36) Credit = 02

Unit-I (Cell Signaling)

1. Signaling and receptors, Properties of cell signaling.
2. Signalling through G-Protein Coupled Receptors(GPCR), tyrosine kinase; second messenger- cAMP & phospholipid, Calcium Ion Signals, electrical signaling.
3. Different signal pathways viz. Pi3K AKT, Hedgehog, Wnt, Notch, TGF beta, Jak stat etc.
4. Nuclear receptors & steroid Hormones.

Unit-II (Cell cycle and Apoptosis)

1. Mammalian cell cycle, phases
2. Regulation of cell cycle- check points, role of different factors and proteins.
3. Apoptosis – mechanism- extrinsic and intrinsic/mitochondrial pathways
4. Autophagy and necrosis - mechanism.

Paper-10B (Practical)

HP-502C

Total Mark = 40 (IA = 16 + ESE = 24) Credit = 02

CONTENTS:

1. Cell cycle chart study
2. Signaling pathways chart study
3. Mitosis and meiosis chart study
4. Karyotyping and chromosomal anomaly chart study.
5. DNA isolation from bacteria/blood/any suitable source
6. Agarose electrophoresis of DNA
7. DNA estimation

8. Pedigree analysis study

Paper-11 (Theory)

HP-503C

Total Mark = 100 (IA = 40 + ESE = 60) Credit = 04

Unit-I (Immunology-I)

1. Immune system, Innate and acquired immunity - their components, functions of T cells, B cells, neutrophil, basophil, eosinophil, NK cells, RE cells, TLR receptors
2. Primary and secondary lymphoid organs
3. Antigen, Immunogen, Epitope, Hapten, Paratope,
4. Complement components of classical and alternative pathways, their activation, and physiological function of complement system, complement deficiencies.

5. Unit-II (Immunology-II)

1. Humoral immunity –Structure, Classification of antibodies, functions.
2. General structure of IgG antibody, monoclonal and polyclonal antibody,
3. Clonal selection theory of antibody production, generation of effector and memory T cell,
4. Class I & II MHC molecules, structure and functions, antigen presentation, T and B cell cooperation in antibody production.

Unit-III (Immunology-III)

1. Antigen antibody interaction.
2. T cell, B cell ontogeny and activation
3. Inflammation, mediators
4. Hypersensitivity Type-I and Type-II.

Unit-IV (Immunology-IV)

1. Clonal selection theory of antibody production.
2. Cell mediated immunity - role of T-cytotoxic cell (CTL) and TH in Cell mediated immunity.
3. Types of HLA, Graft rejection
4. Primary and secondary immune responses,
5. Vaccination: Passive and active immunization, types and uses of vaccine, adjuvants, DNA vaccine.

Paper-12A (Theory)

HP-504C

Total Mark = 60 (IA = 24 + ESE = 36) Credit = 02

Unit-I (Molecular physiological basis of cancer-I)

1. Properties of cancer cells, concept of oncogenes and proto-oncogenes, suppressor gene.
2. Genetic and epigenetic causes of cancer
3. Classification of cancer on the basis of origin
4. Altered metabolic and physiological changes in cancer cells.
5. Molecular and chromosomal changes in cancer: Mutation: Spontaneous and induced mutation, mechanism of transition and transversion, chemical and physical agents inducing mutation, Ames's test, Types- DNA: Structural - Point mutation-deletion, insertion, Frame shift; Functional - Non-sense, mis-sense, silent, null mutation; Chromosomal: i) Structural-Inversion, translocation, deletion, duplication. ii) Number - Euploidy, aneuploidy, Polyploidy.

Unit-II (Molecular physiological basis of cancer-II)

1. Repair mechanism of Mutation: direct repair, excision repair, transcriptional excision repair, mismatch repair, UVr A, B and C mechanism, and SOS repair system.
2. Factors inducing cancer, cancer stem cells.
3. Cancer metastasis.
4. Cancer specific abnormalities in different cell signaling pathways.
5. Concept of chemotherapy and immunotherapy.

Paper-12B (Practical)

HP-504C

Total Mark = 40 (IA = 16 + ESE = 24) Credit = 02

CONTENTS:

1. Blood group determination.
2. Ouchterlony double diffusion assay.
3. Bacterial culture in nutrient agar plate (by streak and spread method).
4. Bacteria culture in nutrient broth (LB media).
5. Study of bacterial growth curve taking O.D. at different time point.
6. Different sterilization methods.
7. Single colony isolation.
8. Gram staining of bacteria.

SEMESTER-VI

Paper-13 (Theory)

HP-601C

Total Mark = 100 (IA = 40 + ESE = 60) Credit = 04

Unit-I (Nervous System-I)

1. Structural organization of different parts of brain and spinal cord. Nerve roots.
2. Brain ventricle concept, CSF composition, formation, circulation and functions. Blood Brain Barrier, Lumbar puncture, Cerebral circulation-course, factors affecting cranial nerves-functions
3. Somato-sensory system: Ascending (sensory) tracts-carrying touch, pain, temperature sensation. Referred pain. Pain inhibiting system, opioids.
4. Motor system: Descending tracts (pyramidal and extra pyramidal systems), Upper motor and lower motor neurons and their lesions, Babinski sign.

Unit-II (Nervous System-II)

1. Functions of spinal cord with special reference to functional changes following hemisection and complete section at different levels of spinal cord. Brown sequard syndrome. Tabes Dorsalis.
2. Cerebellum: Histology, nuclei, connections and functions. Cerebellar diseases.
3. Basal ganglia: structure connections and functions, Parkinson's Disease.
4. Components and functions of Pons Medulla Reticular formation.

Unit-III (Nervous System-III)

1. Stretch reflex: muscle spindle-structure, connections, and function- special reference to muscle tone. Role of different parts of brain in muscle tone maintenance. Spasticity, Rigidity.
2. Maintenance of posture & equilibrium: vestibular apparatus, different postural reflexes-righting reflex. Romberg's sign.
3. Cerebral cortex: Histology, different lobes, areas and their functions.
4. Method of Localization of the functions of cerebral cortex.

Unit-IV (Nervous System-IV)

1. Thalamus: Nuclei, functions. Thalamic animal. Thalamic syndrome.
2. Hypothalamus: Nuclei, functions: Feeding & satiety, Thermoregulation etc.
3. Autonomic Nervous system (ANS): Classification, structural and functional organizations.
4. Neurotransmitter in ANS.

Paper-14A (Theory)
HP-602C- Special senses
Total Mark = 60 (IA = 24 + ESE = 36) Credit = 02

Unit-I (Special senses-I)

1. Vision: anatomy and general structure of eye ball,
2. Structure and function of layers of eye ball
3. Blood circulation of eye
4. Visual pathway, Photochemical changes of retina on exposure to light,
5. Light and dark adaptation,
6. Mechanism of development of glaucoma, diabetic retinopathy and cataract.
7. Theories of color vision, color blindness.

Unit-II (Special senses-II)

1. Audition: Structure and function of auditory apparatus, organ of corti.
2. Auditory pathways & centers.
3. Mechanism of hearing. Perception of sound frequency and loudness. Deafness, audiometry, hearing tests.
4. Olfaction and gustation: Structure and functions of receptor organs, nerve pathways, centers.
5. Taste and smell adaptation, abnormalities of olfactory and taste sensation.

Paper-14B (Practical)
HP-602C
Total Mark = 40 (IA = 16 + ESE = 24) Credit = 02

CONTENTS:

1. Determination of heart rate and blood pressure at rest and after exercise.
2. Determination of PFI and graphical representation of recovery heart rate.
3. Determinations of VO₂ max indirectly by Queens's college step test.
4. ECG demonstration.
5. Model electro cardiogram study in detail with abnormalities.
6. Optometric study – acuity chart, far and near vision.
7. Hearing test with tuning fork.

Paper-15 (Theory)

HP-603C

Total Mark = 100 (IA = 40 + ESE = 60) Credit = 04

Unit-I (Exercise & Sports Physiology -I)

1. Introduction to exercise & sports physiology- scope, Importance. Skeletal muscle types and their response to exercise. Types of exercise: isotonic, isometric etc.
2. Energy for exercise: source of energy in exercise, Nutrients used during exercise, energy stores.
3. Energy system for exercise and recovery--Aerobic and anaerobic energy system- anaerobic power, OBLA, Lactate threshold.
4. Aerobic energy system-Aerobic power-VO₂ max; measurements, factors controlling. EPOC or O₂-debt -lactacid & alactacid. Fatigue causes.

Unit-II (Exercise & Sports Physiology-II)

1. Physiological responses in exercise: Effects of exercise on cardio-vascular & respiratory system.
2. Physiological responses to exercise in the heat and cold environment. Heat cramps, heat stroke, frostbite.
3. Women in sports: Sex difference in physiological responses in exercise.
4. Pregnancy and menstruation in relation to exercise and Sports.

Unit-III (Exercise & Sports Physiology-III)

1. Exercise Training: Training principles; aerobic & anaerobic training, resistance training;
2. Effects of training on respiratory, cardio-vascular and muscular system. Concept of Overtraining, detraining. High altitude training.
3. Nutrition and ergogenic aids in sports: Role of nutrients in sports, pregame meal; carbohydrate loading, spacing of meals, glycogen loading, fluid replacement.
4. Ergogenic aids- effects of creatine, carnitine, erythropoietin, alkalizers, anabolic steroids, amphetamines, caffeine etc. Concept of Doping in sports.

Unit-IV (Yoga)

1. Yoga and Human performance: Introduction to Yoga,
2. Traditional yogic practices- Asanas, Pranayamas, meditations.
3. Physiological applications of yoga
4. Experimental evidences exhibiting benefits of yoga.

Paper 16A (Theory)

HP-604C

Total Mark = 60 (IA = 24 + ESE = 36) Credit = 02

Unit-I (Work Physiology)

1. Work Physiology –definition and nature – isotonic, isometric and isokinetic, positive and negative work. Concept of physiological work, static and dynamic work. Power and work capacity relation.

2. Classification of Work-load – light, moderate and heavy work-depending on intensity and duration of work.
3. Different methods of assessment of energy cost for various physical work-- direct and indirect methods with their limitations.
4. Assessment of energy cost by using bicycle ergometer and treadmill.

Unit-II (Ergonomics and Occupational Health)

1. Ergonomics—definition, basic concept of ergonomics and its application. Work Study, time study and motion study-basic concept and application.
2. Concept of system design; Effect of Man, Machine and Environment in System Design; Failure of System – accident.
3. Static and Dynamic Anthropometry—concept and application in design and development. Application of Ergonomics for the development of safety
4. Occupational health—definition and basic concept, contribution of Bernardino Ramazzini.
5. Occupational hazards – Physical, chemical and biological hazards. Occupational diseases – silicosis, asbestosis and work-related musculoskeletal disorders.

Paper-16B (Practical)

HP- 604C

Total Mark = 40 (IA = 16 + ESE = 24) Credit = 02

CONTENTS:

1. Determination of body fat percentage by indirect method- using skinfold caliper.
2. Determination of somatotype (endomorph, mesomorph & ectomorph) of the body
3. Determination/demonstration of muscular efficiency and fatigue by Mosso's ergograph
4. Determination grip strength by Grip dynamometer
5. Effect of exercise on respiratory pattern. Effect of hyperventilation on breath holding.
6. Measurement of wet bulb globe temperature (WBGT) indices.
7. Measurement of environmental temperature – dry bulb and wet bulb, relative humidity, air velocity. Determination of sound levels by sound level meter and noise index.

Paper-17 (Theory)

HP-701C

Total Mark = 100 (IA = 40 + ESE = 60) Credit = 04

Unit-I (Metabolic Biochemistry-I)

1. Glycolysis, Gluconeogenesis,
2. Pentose phosphate pathway
3. Glycogenesis and glycogenolysis
4. TCA cycle, Energetics of glycolysis and TCA cycle
5. Cori cycle

Unit-II (Metabolic Biochemistry-II)

1. β -oxidation of fatty acids and Ketone body metabolism.
2. Biosynthesis of fatty acids,
3. Cholesterol synthesis and functions
4. Lipoproteins- VLDL, LDL, HDL.

Unit-III (Metabolic Biochemistry-III)

1. Amino acids - Amino acid pool, Amination, Deamination, Transamination and Decarboxylation. energy producing role of aminoacids
2. Catabolism of amino acids, Urea cycle.
3. Integration of major metabolic pathways of energy metabolism.
4. Inborn error of metabolism. Glycogen storage disease, phenylketonuria, albinism.
5. Catabolism of purine and pyrimidines. Disorders of purine and pyrimidine metabolism.

Unit-IV (Metabolic Biochemistry-IV)

1. Gibbs free energy, free energy changes and redox potentials, High energy compounds.
2. Electron transport chain, components and reactions of the electron transport chain.
3. Oxidative phosphorylation-mechanism-different hypothesis: chemo-osmotic hypothesis.
4. Structural and functional aspects of F₀, F₁ATPase, Inhibitors of oxidative phosphorylation; uncouplers.

Paper 18A (Theory)

HP-702C

Total Mark = 60 (IA = 24 + ESE = 36) Credit = 02

Unit-I (Nutrition & Dietetics-I)

1. Nutritional importance and dietary requirements of carbohydrate, proteins and fat. RDA- Carbohydrates, protein, fats and other nutrients. Complete and incomplete proteins, biological value of proteins, essential amino acids and fatty acids.
2. Nutritional requirements and formulation of balanced diet for adolescents and college students, workers with sedentary, moderate and heavy physical activity, pregnant and lactating woman.
3. BMR – definition and determination, factors affecting BMR and its significance.
4. Biological value of protein, RQ, SDA and RDA.

Unit-II (Nutrition & Dietetics-II)

1. Chemical nature and structure of Vitamins, Vitamins- sources, daily requirements, deficiency symptoms and functions, hyper vitaminosis and hypo vitaminosis
2. Marasmus, kwashiorkor
3. Minerals and trace elements– iron, zinc, magnesium, calcium and iodine: physiological functions, source, requirements, deficiency symptoms
4. Calorific value of foods; SDA of foods, RQ. their definition and physiological importance.
5. Food groups, basis and formulation of balanced diet for Growing child. Adult man and Women. Pregnant and Lactating mother, Elderly people.
6. Dietary Fibre; Recommended intake of fibre. Glycemic Index (GI); Factors affecting GI of foods; GI in chronic diseases. Pro-biotics- concept and benefits.

Paper-18B (Practical)

HP- 402C

Total Mark = 40 (IA = 16 + ESE = 24) Credit = 02CONTENTS:

1. Glucose estimation by enzymatic.
2. Glucose estimation by titrimetric method.
3. Anthropometric Nutritional assessment.
4. Estimation of cholesterol.
5. Study of diet chart as per age group and gender.
6. Study of diet chart for pregnant and lactating mother.
7. Study of diet chart in metabolic disease.

Paper-19 (Theory)

HP-703C

Total Mark = 100 (IA = 40 + ESE = 60) Credit = 04

Unit-I (Embryology and Developmental Biology-I)

1. Introduction to Developmental Biology, Details of Mitotic and Meiotic cell division.
2. Stem Cells: basic concept, potentials, mechanisms of cell differentiation, and morphogenesis.
3. Ultrastructure of egg and sperm, Spermatogenesis and Oogenesis and its regulation.
4. Embryonic stem cells and their signal pathways.
5. Genetic control of different genes related to development.

Unit-II (Embryology and Developmental Biology-II)

1. Early embryonic development: fertilization, cleavage, gastrulation and axis formation.
2. Formation of germ layers: Derivatives of germ layers.
3. Implantation, Placentation and Extra embryonic Membranes.
4. Placental disorders.
5. Foetal Circulation.
6. Development of limb.
7. Molecular basis of sex determination, aging and senescence.
8. Developmental disorders.

Unit-III (Stress Physiology-I)

1. ROS generation in the body-mechanism
2. Role of superoxide dismutase catalase. Glutathione in oxidative stress physiology.
3. High altitude physiology: Barometric & partial pressure of oxygen at high altitude, changes in the body in high altitude
4. Motion sickness, acclimatization to high altitude.

Unit-IV (Stress Physiology-II)

1. Aviation Physiology - Accelerative and gravitational force
2. Effect of positive and negative G force on body.

3. Space physiology - Effects of weightlessness on Cardiovascular system, musculoskeletal system, blood, immune system
4. Space motion sickness.

Paper 20A (Theory)

HP-704C

Total Mark = 60 (IA = 24 + ESE = 36) Credit = 02

Unit-I (Neurochemistry)

1. Concept of neuro-transmitter,
2. Classification- Inotropic, metabotropic, fast, slow.
3. Structure, subtype and functions of different neurotransmitter receptors (Acetyl choline, catecholamines, glutamate, GABA etc.) and
4. Mechanism of action of neurotransmitters, co-transmitters.

Unit-II (Behavioral Physiology, Higher brain functions & Chronobiology)

1. Emotion & Behavior: Limbic system, neural circuitry of limbic system-Papez circuit. Functions of Limbic system-emotions, motivation, Behavior- fear & rage, Reward & punishment. Sham rage, Kluver-Bucy syndrome. Specific functions of other parts of limbic system: Hippocampus, Amygdala. Aminergic system in mood, depression, manic depressive psychosis-schizophrenia.
2. Higher functions of brain: –learning, memory, classification of memory, molecular basis of memory- consolidation of memory. Amnesia, Dementia, Alzheimer's disease.
3. Functions of neocortex. Prefrontal cortex. Wernicke's area and Broca's area. Physiology of language and speech, Aphasia. Idea about Cognition.
4. States of Brain activity: EEG, different waves, physiological basis. Sleep, classification. Mechanism of sleep. Changes in the EEG at different stages of wakefulness and sleep. Sleep Disorder. Epilepsy.
5. Circadian rhythm and different physiological processes.

Paper-20B (Practical)

HP- 704C

Total Mark = 40 (IA = 16 + ESE = 24) Credit = 02

CONTENTS:

1. Chart / model study -different embryological phases.
2. Placenta model study – normal and abnormal.
3. Determination of Km value of enzyme.
4. Effect of temperature on enzyme action.
5. Effect of pH on enzyme action.

6. Chart study of different EEG waves.
7. Recording of self / subject heart rate at different time intervals (24h scale) and preparation of curve.

Paper-21 (Theory)

HP-405C

Total Mark = 100 (IA = 40 + ESE = 60) Credit = 04

Unit-I (Medical Microbiology-I)

1. Structure & morphological classification of bacteria, virus & fungi. Structure of bacterial cell wall, difference between bacterial & fungal cell wall, LPS layer, Structure of pili, flagella, spores and cysts; functions
2. Classification of virus, bacteriophage life cycle
3. Bacterial growth curve: different phases, factors affecting growth curve.
4. Significance of different phases of bacterial growth curve.

Unit-II (Medical Microbiology-II)

1. Control of microbial growth: Physical and Chemical methods used in sterilization, disinfection and pasteurization.
2. Etiological agents of gastrointestinal infection, bacterial, helminthic and protozoal infection
3. Bacterial, viral, parasitic and fungal infection of respiratory tract
4. Bacterial, viral, parasitic and fungal infection of central nervous system

Unit-III (Medical Microbiology-III)

1. Food microbiology: Beneficial and harmful microorganisms in food, causative organisms of food-borne infections- mode of transmission and methods of prevention.
2. Bacterial metabolism: Fermentation mechanism
3. Bacterial conjugation, transduction & transformation.
4. Bacterial biofilm, composition and function

Unit-IV (Medical Microbiology-IV)

1. Different types of antibiotics & their mode of action, mechanism of antibiotic resistance.
2. Antiviral drugs and their mode of actions
3. Host parasite interaction: Recognition and entry processes of different pathogens like bacteria, viruses into animal host cells, alteration of host cell behaviour by pathogens.
4. Pathophysiology of Some common diseases – Bacterial disease - cholera, Parasitic disease - amebiasis, malaria, Viral disease- HIV.

Paper 22A (Theory)

HP-802C- Environmental Physiology & Public Health Issues

Total Mark = 60 (IA = 24 + ESE = 36) Credit = 02

Unit-I (Environmental Physiology)

1. Different environmental pollutants effecting human health.

2. Air, Water and Noise pollution.
3. Sources and effects of Chlorinated hydrocarbons on human body.
4. Effects of Organophosphorus and Organocarbamates compounds on human system.
5. Heavy metal toxicity - Lead, Arsenic, Chromium, Nickel.
6. Effects of Ionizing and non-ionizing radiations.
7. Global warming, ozone depletion, greenhouse effect, carbon footprint.

Unit-II (Public Health Issues)

1. Basic idea about community & public health issues.
2. Malnutrition in a community, over nutrition and possible remedial measures. Diet management of obese, diabetic, hypertensive individuals and athletes. Iron and iodine deficiency.
3. Population problem - principles and methods of family planning, Problem of infertility and Assisted Reproductive Technologies.
4. PCM - Marasmus, Kwashiorkor, Marasmic Kwashiorkor, endemic goiter, nutritional anemias, rickets, osteomalacia, xerophthalmia, beriberi and their social implications of immunization against diseases.
5. Etiology and prevention of communicable diseases – Malaria, Cholera, Dengu, Hepatitis, HIV.
6. Etiology and prevention of non-communicable diseases - Hypertension, Obesity, Diabetes.

Paper-22B (Practical)

HP- 802C

Total Mark = 40 (IA = 24 + ESE = 16) Credit = 02

CONTENT: Review Writing

Paper-23 (Theory)

HP-803C

**Molecular Biological, Cell Biological & Immunological Techniques Total Mark =
100 (IA = 40 + ESE = 60) Credit = 04**

Unit-I (Molecular Biological Techniques-I)

1. Electrophoresis - general principle, native and SDS-Polyacrylamide gel electrophoresis.
2. Principles of chromatography- Gel-exclusion, Ion-exchange, affinity chromatography.
3. Spectrophotometry- working principles. Lamda max.

Unit-II (Molecular Biological Techniques-II)

1. Recombinant DNA technology: restriction endonuclease, DNA cloning,
2. cloning vector- plasmid and phage vectors, cloning of DNA into cloning vectors.
3. DNA probe, Colony hybridization, Southern blotting, northern blotting, Western blotting.
4. Principle of Polymerase chain reaction (PCR)

Unit-III (Cell Biological Techniques)

1. Microscopy: Optical microscope and phase contrast microscope- their basic principles. Scanning Electron Microscopy and Transmission Electron Microscopy- their applications in cell biology.
2. Fluorescence microscopy, Advantages of confocal microscopy.
3. Principles applications of Fluorescent Activating Cell Sorting (FACS)
4. Basics about tissue fixatives, embedding and tissue section processing for staining; types of staining.

Unit-IV (Immunological Techniques)

1. Immunoprecipitation,
2. Radio-immunoassay,
3. Enzyme Linked Immuno Sorbant Assay (ELISA) - direct, indirect.
4. Polyclonal antibody development, Hybridoma technology.

Paper 24A (Theory)
HP-804C-
Biostatistics, Research Methodology
Total Mark = 60 (IA = 24 + ESE = 36) Credit = 02

Unit-I (Biostatistics)

1. Principles of statistical analysis of biological data.
2. Basic concepts of variables, population and sampling.
3. Different classes of statistics - mean, media, mode, mean deviation, variance, standard deviation, standard error of mean.
4. Degrees of freedom, probability, normal distribution.
5. Testing of hypothesis – Null hypothesis, errors of inference, level of significance,
6. t-test, Chi-square test, one way ANOVA.
7. Correlation coefficient – linear correlation and linear regression.

Unit-II (Research Methodology & Ethical issues in Biomedical Research)

1. Research methodology: Meaning of research, objectives and significance of research, types of research.
2. Scientific methods in research, selecting a research problem, importance of formulating a research problem, sources of research problems, considerations in selecting a research problem, steps in formulating a research problem, survey and review of literature, the formulation of research objectives.
3. Developing hypothesis and verifying concepts, research design, defining the population & selecting the sample, choice of methods.
4. Need for research design, the concept of sampling, aims in selecting a sample, types of sampling, sample design and its different steps, need for basis of selecting a sampling procedure, characteristics of a good sample design, types of data.
5. Types of research, fundamental or basic research, applied or practical research, Experimental research, Lab experiments and field experiments,
6. Reporting: Preparation & submission of research report.

Paper-24B (Practical)
HP- 408C
Total Mark = 40 (IA = 16 + ESE = 24) Credit = 02

CONTENT: Project Work

Suggested Readings:

1. Text book of Medical Physiology, by A.C. Guyton. W.B. Saunders Co.
2. Best & Taylor's Physiological Basis of Medical Practice, O. P Tandon & Y. Tripathi, Lippincott Williams& Wilkins
3. Ganong's Review of Medical Physiology. Barrett et.al, McGraw Hill Lange

4. Harper's Illustrated Biochemistry, V.W. Rodwell and others, Lange
5. Lehninger's Principles of Biochemistry. By D.L. Nelson and M. M. Cox, Worth Publishers Inc.
6. Text Book of Biochemistry, by E.S. West. W.R. Todd. H.S. Mason. J.T. Van Bruggen. The Macmillan Company.
7. Biophysics and Biophysical Chemistry, D. Das. Academic Publishers.
8. Samson Wright's Applied Physiology, C.A. Keele. E Neil & N. Toels. Oxford University Press.
9. Physiology, R.M. Berne & M.N. Levy, C.V. Mosby Co.
10. Basic Histology, L.C. Junqueira & J Carneiro, McGraw- Hill .
11. diFiore's Atlas of Histology, V.P. Eroschenko, Wolters-Kluwer
12. The Cell – A Molecular Approach, G. M Cooper & R. E Hausman, ASM Press SINAUER.
13. Cell Biology, G.Karp, John Wiley & Sons, Inc.
14. Core Text Book of Neuro-Anatomy, by M.B. Carpenter; the Williams and Wilkins Company.
15. The Human Nervous System, by Charles Nobach, Mc Graw Hill Book Co.
16. The Human Nervous System. By M.L. Barr & J.A. Kierman, Harper & Row.
17. Essential Food and Nutrition, by M. Swaminathan. The Bangalore Printing & Publishing Co.
18. Cell & Molecular Biology, EDP De Robertis & EMF De Robertis; Lea & Febiger
19. Molecular Biology of the Gene, by J.D. Watson, H.H. Nancy & others; Benjamin Cummings.
20. Molecular Biology of the Cell, B. Alberts and others, Garland.
21. Textbook of Medical Physiology, Indu Khurana, Elsevier
22. Biochemistry, J. M. Berg, J.L. Tymoczko & L. Stryer, W.H. Freeman
23. William's Text Book of Endocrinology Larsen et. al An Imprint of Elsevier.
24. Endocrinology, Mac E. Hadley, Pearson Education.
25. Vander's Human Physiology, E.P. Widmaier et al., McGraw-Hill, Higher Education.
26. Endocrinology. Vols.I , II and III by L.O. DeGroot. W.B. Saunders Co.
27. Langman's Medical Embryology by J.W. Sadler, Lippincott Williams and Wilkins.\
28. Human Embryology by I. Singh & G. P Pal, McMillan.
29. Statistics in Biology and Psychology by D. Das and A. Das Academic Publishers.

30. An Introduction to Biostatistics, N. Gurumani, M.J.P. Publishers, Chennai.
31. Microbiology, Pelczar Tata McGrawhill.
32. General Microbiology by Stanier et.al, Prentice Hall.
33. Kuby Immunology by T.J Kindt et.al, W.H Freeman.
34. Cellular and Molecular Immunology, A.K. Abbas et.al, Elsevier.
35. Ergonomics Man in His working Environment. Murrell K. 3rd Ed. Springer.
36. Introduction to Ergonomics,R.S. Bridger, Routledge : Taylor & Francis group.
37. Park's Textbook of Preventive and Social Medicine, K.Park, M/s. Banarasidas Bhanot, 2015.
38. Communicable Disease Control Handbook, Jeremy Hawker et.al, Blackwell Publishing.
39. Physiology of Sport and Exercise. J. H. Wilmore, D. L. Costill, W. Larry Kenney. Human Kinetics
40. Textbook of Work Physiology: Physiological Bases of Exercise. Per- Olof Åstrand, Kaare Rodahl, Hans A. Dahl, Sigmund B. Strømme . Human Kinetics
41. Fox's Physiological Basis for Exercise and Sport by M. L.Foss. S. J. Keteyian, E. L. Fox , William C Brown Pub
42. Essentials of Exercise Physiology, V.L. Katch, W.D. McArdle, F.I. Katch, Wolters Kluwer.
43. Chronobiology – The Biological Timekeeping, J.C. Dunlap, Sinauer Association.



Tripura University
(A Central University)

Course Structure of UG Programme
As per NEP-2020 under Tripura University
HUMAN PHYSIOLOGY GENERAL (MINOR)

Year	Semester	Paper	Credit	Total marks	Unit-I	Unit-II	Unit-III
1 st	1 st HP-101M	Paper – 1A Theory	3	60 (IA=24 + ESE=36)	Structural and Functional basis of Human Body	Biophysics and Physicochemical Principles	Chemistry of Bio molecules
		Paper-1B Practical	1	40 (IA=16 + ESE=24)	Based on theory paper 1A		
	2 nd HP-102M	Paper-2A Theory	3	60 (IA=24 + ESE=36)	Physiology of Blood and body fluids-I	Physiology of Blood and body fluids-II	Physiology of Blood and body fluids-III
		Paper-2B Practicals	1	40 (IA=16 + ESE=24)	Based on theory paper 2A		
2 nd	3 rd HP-201M	Paper-3A Theory	3	60 (IA=24 + ESE=36)	Cardiovascular System-I	Cardiovascular System-II	Cardiovascular System-III
		Paper 3B Practicals	1	40 (IA=16 + ESE=24)	Based on theory paper 3A		
	4 th HP-202M	Paper-4A Theory	3	60 (IA=24 + ESE=36)	Respiratory System-I	Respiratory System-II	Respiratory System-III
		Paper 4B Practicals	1	40 (IA=16 + ESE=24)	Based on theory paper 4A		
3 rd	5 th HP-301M	Paper-5A Theory	3	60 (IA=24 + ESE=36)	Digestion & Metabolism -I	Digestion & Metabolism-II	Digestion & Metabolism-III
		Paper 5B Practicals	1	40 (IA=16 + ESE=24)	Based on theory paper 5A		
	6 th HP-302M	Paper-6A Theory	3	60 (IA=24 + ESE=36)	Excretory Physiology-I	Excretory Physiology-II	Body temperature regulation
		Paper 6B Practicals	1	40 (IA=16 + ESE=24)	Based on theory paper 6A		
4 th	7 th HP-401M	Paper-7A Theory	3	60 (IA=24 + ESE=36)	Endocrinology and Reproductive Physiology-I	Endocrinology and Reproductive Physiology-II	Endocrinology and Reproductive Physiology-III

		Paper 7B Practicals	1	40 (IA=16+ESE=24)	Based on theory paper 7A		
	8th HP-402M	Paper-8A Theory	3	60 (IA=24 + ESE=36)	Nerve - Muscle Physiology	Nervous system	Special senses
		Paper-8B Practicals	1	40 (IA=16 + ESE=24)	Based on theory paper 8A		

**DETAILED COURSE CONTENT OF
HUMAN PHYSIOLOGY GENERAL (MINOR)**

1st YEAR
Semester-I
Paper-1A- (Theory)
HP-101M

Full marks- 60 (Internal assessment-24; End Sem. Exam. - 36)

Unit-1: Structural and Functional basis of Human Body

1. General structure and function of eukaryotic cell, Cell->tissue->organ->system concept.
2. Different types of human tissues-Functions.
3. Musculo-skeletal system: Types of muscle, Bone, Cartilage & ligament. Joints types-functions.
4. General idea about functional aspect of human body organ and organ systems.

Unit-2: Biophysics and Physicochemical Principles

1. Diffusion, Osmosis, Osmotic pressure. Tonicity-isotonic, hypertonic, hypotonic.
2. Basic idea about cell membrane transport: Passive transport-ligand and voltage gated ion channel transport, facilitated diffusion. Active transport, secondary active transport.
3. Gibbs-Donnan membrane equilibrium- its biological application.
4. Acids, bases, pH and Buffers: Definition, biological significance. Henderson-Hasselbalch equation. Important Buffers in the Body.

Unit-3: Chemistry of Bio molecules

1. Chemistry, classification and physiological importance of carbohydrates. Properties of carbohydrates.
2. Chemistry, classification and physiological importance of Proteins.
3. Chemistry, classification and physiological importance of Lipids & fatty acids. Mono and poly unsaturated fatty acids. Sterols.
4. Enzyme classification. Concept of apoenzyme, holoenzyme, coenzyme, cofactors, isoenzyme. Mechanism of enzyme action- models; activation energy; active site, regulatory site-Allosteric enzyme.

Paper-1B-(Practical)

HP-102M

Full marks-40(Internal assessment-16; End Sem. Exam. -24)

CONTENTS:

1. Study of Models / Charts of different body organ systems & organs – Anatomical position, Structure & Functions.
2. Study of Human Skeleton
3. Study of Body Anthropometry- Stature, weight, sitting height, shoulder height (standing), Elbow height (standing), Hip height (standing), hand length, shoulder elbow length, leg length, shoulder breadth (biacromial), Arm reach from wall (Arm span), Knee to Knee Breadth, Elbow to elbow breadth, Head circumference, Shoulder circumference, Chest circumference, waist circumference, hip circumference. Calculation of BMI, BSA, WHR, Head and Chest circumference ratio.

Semester-II
Paper-2A (Theory)
HP- 201M

Full marks-60 (Internal assessment-24; End Sem. Exam. -36)

Unit-1: Physiology of Blood and body fluids-I

1. Composition and general functions of blood. Plasma - Plasma proteins- types and functions.
2. Haematopoiesis. Haemopoietic stem cell, Site of Blood cells Formation. Erythropoiesis –factors effecting. Fate of RBC.
3. Tissue fluid and Lymph- Composition and function.
4. ESR-its importance. Haemoglobin-structure, types. Thalassemia and Haemoglobinopathies- HbS, HbE, HbD.

Unit-2: Physiology of Blood and body fluids-II

1. Blood coagulation : mechanism, role of platelets. Hemophilia, purpura
2. Blood group -ABO, Rh system. Blood transfusion and its hazards.
3. Blood volume- Factor effecting and determination of blood volume.
4. Anaemia-types, leukemia, leukopenia, polycythemia.

Unit-3: Immunology

1. WBC-morphology, types. Functions of different types of WBC:
2. Primary and secondary lymphoid organ. Antigen, Immunogen. Primary and secondary immune response. Innate and acquired immunity.
3. Immunity-- Humoral immunity - classification, functions of antibodies. General structure of IgG antibody.
4. Cell mediated immunity-Role of NK cells, T_H and T_C cells. Vaccination.

Paper-2B (Practical)

HP- 201M

Full marks-40 (Internal assessment-16; End Sem. Exam. -24)

CONTENTS:

1. Introduction to compound microscope.
2. Preparation and staining of blood film with Leishman's stain. Identification of blood cells.
3. Determination of differential leukocyte count (DLC).
4. Hemoglobin estimation by Sahli's hemoglobinometer.
5. Preparation of haemin crystals.
6. Determination of bleeding time and clotting time.
7. Determination of Blood group.

2nd YEAR
Semester-III
Paper- 3A (Theory)
HP- 301M

Full marks-60 (Internal assessment-24; End Sem. Exam. -36)

Unit-1: Cardiovascular System-I

1. Anatomy of the heart. Properties of cardiac muscle. Origin and propagation of cardiac impulse-Junctional tissues. Heart Block.
2. Electrocardiography- Principles of Electrocardiography, Normal electrocardiogram, different waves, intervals and segments; different electrocardiographic lead systems.
3. Cardiac cycle -Pressure and volume changes. Heart sounds. Murmurs. Arterial pulse. Arrhythmia.
4. Heart rate- Bradycardia, Tachycardia, Factors controlling heart rate.

Unit 2: Cardiovascular System-II

1. Cardiac output - factors affecting, Starling's law of heart. Measurement by application of Fick's principle.
2. Innervations of the heart and blood vessels,
3. Cardiac and vasomotor reflexes.
4. Blood pressure- Normal value, Physiological variation. Hypertension-types.

Unit-3: Cardiovascular System-III

1. Blood vessels-types, structure. Hemodynamics: velocity of blood flow, nature of blood flow.
2. Coronary Circulation-course and peculiarities. Coronary artery disease (CAD)-Atherosclerosis.
3. Effects of exercise on cardiovascular system.
4. Immediate and delayed effects of hemorrhage on cardiovascular system.

Paper-3B (Practical)

HP-301M

Full marks-40 (Internal assessment-16; End Sem. Exam. -24)

CONTENTS:

1. Identification of different pulse and diurnal variation.
2. Determination of pulse rate in different posture.
3. Determination of arterial blood pressure by sphygmomanometer.
4. Measurement of PFI by Harvard step test (modified) and graphical presentation of the recovery heart rate.
5. Measurement of hand grip strength by hand grip dynamometer.

Semester-IV
Paper- 4A (Theory)
HP- 401M

Full marks-75(Internal assessment-30; End Sem. Exam. -45)

Unit 1: Respiratory System-I

1. Functional Anatomy and histology of the lung and airways. Alveolar cells and functions.
2. Physical principles of gas exchange, Partial pressure and composition of normal atmospheric gases in inspired, expired, alveolar air and blood.
3. Transport of blood gases: Oxygen transport-mechanism and carbon- di-oxide transport, mechanism.
4. Obstructive & Restrictive lung disease-Asthma, Emphysema. Asphyxia, Cyanosis. Dyspnoea, -brief idea.

Unit-2: Respiratory System-II

1. Spirometry: Lung volumes and capacities.
2. Mechanism of respiration. Alveolar surface tension and surfactant.
3. Regulation of respiration: Respiratory centers, Chemoreceptors.
4. Neural control and chemical control of respiration.

Unit-3: High Altitude, Deep sea and Exercise Physiology

1. Respiratory abnormalities: High Altitude Sickness- Acclimatization. High altitude pulmonary edema (HAPO). Oxygen therapy.
2. Decompression sickness- caisson's disease -cause, effect. Hypoxia- Types.
3. Effect of exercise on respiratory system.
4. Maximal aerobic power (VO_2 max) definition and significance. O_2 debt- lactic and alactic.

Paper-4B (Practical)

HP-401M

Full marks-40 (Internal assessment-16; End Sem. Exam. -24)

CONTENTS:

1. Determination of breathing rate.
2. Measurement of lung volumes and capacities by spirometer or supplied curve.
3. Determination of obstructive or restrictive lung diseases from the supplied chart of FVC-FEV1 measurement.
4. Determination of Peak Expiratory Flow Rate and interpretation of result.
5. Determination of VO_2 max by Queens College step test.

3rd YEAR
Semester-V
Paper- 5A (Theory)
HP-501M

Full marks-60 (Internal assessment-24; End Sem. Exam. -36)

Unit-1: Digestion & Absorption

1. Anatomy and histology of alimentary tract & digestive glands.
2. Mechanism of swallowing, Movements of alimentary canal. Peristalsis.
3. Composition and function of salivary, gastric, pancreatic and intestinal juice and bile. Digestion and absorption of carbohydrates, proteins and fats.
4. Gastro-intestinal hormones. Bile and its functions, enterohepatic circulation of bile salts.
5. Vitamins & minerals-sources, functions and deficiency symptoms.

Unit-2: Metabolism I

1. Glycolysis and TCA cycle - pathway and significance.
2. Gluconeogenesis, pentose phosphate pathway
3. Glycogenesis, Glycogenolysis- pathway and significance.
4. Energetic of glycolysis and TCA cycle.

Unit-3: Metabolism II

1. Fatty acid biosynthesis, β -oxidation,
2. Ketone body synthesis and significance.
3. Synthesis and function of cholesterol,
4. Ketogenic and glucogenic amino acids, Transamination and Deamination, Urea cycle.

Paper-5B (Practical)

HP-501M

Full marks-40 (Internal assessment-16; End Sem. Exam. -24)

CONTENTS:

1. Qualitative identification of physiologically important substances –
2. HCL, Lactic acid, Uric acid,
3. Albumin, Peptone, Starch, Dextrin, Glucose,
4. Fructose, Lactose, Maltose, Sucrose,
5. Bile salt, Acetone, Glycerol, urea.

Semester-VI

Paper- 6A (Theory)

HP-601M

Full marks-60 (Internal assessment-30; End Sem. Exam. -45)

Unit-1: Excretory System-I

1. Histology, Structural and Anatomy of kidney and nephron. Glomerular filtration, GFR, measurements, regulation.
2. Juxta-glomerular apparatus.
3. Formation of hypotonic and hypertonic urine formation, Counter-current mechanism.
4. Non-excretory functions of kidney.

Unit-2: Excretory System-II

1. Regulation of acid-base balance of the body- Role of kidney.
2. Physiology of urinary bladder and micturition.
3. Normal and abnormal constituents of urine, and pathophysiological significance.
4. Renal function tests. Disorders of renal functions. Artificial kidney.

Unit-3: Body temperature regulation

1. Histology and functions of skin.
2. Skin wounds, classification and phases and mechanisms of wound healing.
3. Sweat glands –structure and composition of sweat.
4. Mechanism of sweat formation, secretion and its regulation. Insensible perspiration. Heat Stress, Pyrexia, hyperthermia and hypothermia.

Paper-6B (Practical)

HP-601M

Full marks-40(Internal assessment-16; End Sem. Exam. -24)

CONTENTS:

1. Study of Models for anatomical position and functions of organs of digestive system and excretory system and skin.
2. Study and identification of histological slides of digestive system and excretory system.
3. Urine analysis: Identification of abnormal constituents of urine (albumin, ketone, glucose, bile salt).
4. Preparation of buffer solution and determination of pH.

4th YEAR
Semester-VII
Paper- 7A (Theory)
HP- 701M

Full marks-60 (Internal assessment-24; End Sem. Exam.-36)

Unit-1: Endocrinology-I

1. Concept of autocrine, paracrine and endocrine system. Anatomical organization of endocrine glands.
2. Hypothalamic releasing factors. Hypothalamo-hypophyseal portal system
3. Histology of pituitary gland. Anterior and posterior pituitary gland hormones and their functions.
4. Hypo and hyper secretion of pituitary hormones.

Unit-2: Endocrinology-II

1. Thyroid and parathyroid glands histology, hormones and their functions.
2. Adrenal gland- histology, hormones and their functions.
3. Pancreas - histology, hormones and their functions.
4. Diabetes mellitus-types.

Unit-3: Reproductive Physiology

1. Anatomical organization of male and female reproductive organs. Primary and accessory sex organs and secondary sex characters. Physiology of puberty.
2. Histology of testis. Endocrine functions of testis. Spermatogenesis.
3. Histology of ovary. Ovarian hormones and their functions. Oogenesis.
4. Menstrual cycle
5. Fertilization, Implantation and Parturition.

Paper-7B (Practical)

HP- 701M

Full marks-40(Internal assessment-16; End Sem. Exam. -24)

CONTENTS:

1. Study of Models for anatomical position and functions of organs of endocrine glands and reproductive system
2. Study and identification of histological slides of endocrine glands and reproductive system.
3. Study of Charts on—Spermatogenesis and oogenesis.

Semester-VIII
Paper- 8A (Theory)
HP- 801M

Full marks-60 (Internal assessment-24; End Sem. Exam. -36)

Unit-1: Nerve -Muscle Physiology

1. Structure, properties and classification of Neurons and Neuroglia.
2. Resting membrane potential (RMP). Action potential (AP), ionic basis, characteristics of AP, propagation in different types of nerve fibers.
3. Synapse, structure, classification, Transmission of nerve impulse through synapse. Neuromuscular Junction (NMJ)- structure, motor unit, propagation of nerve impulse through the neuro-muscular junction.
4. Receptors, classification, types, Reflex, arc, classification.
5. Structure of skeletal muscle. Mechanism of skeletal muscle contraction.

Unit-2: Nervous system

1. Introduction to Nervous system. Structural organization of brain and spinal cord..
2. CSF and functions of CSF. Blood Brain Barrier.
3. Somato-sensory system: Ascending (sensory) tracts-carrying touch, pain, temperature sensation.
4. Motor system: Descending tracts (pyramidal and extra pyramidal systems), Upper motor and lower motor neurons and their lesions.
5. Autonomic Nervous system (ANS): Classification, structural and functional organizations. Neurotransmitter in ANS.
6. Thalamus, hypothalamus, basal ganglion and cerebellum-structure and functions.

Unit-3: Special senses

1. Vision: anatomy and structure of different layers of eye ball, cornea, lens, aqueous and vitreous humor.
2. Blood supply to different layers of eye. Histology of retina and transmission of light signal. Functions of iris, lachrymal gland secretion and functions. Myopia and hypermetropia, color blindness,
3. Mechanism of development of cataract, glaucoma.
4. Mechanism of hearing and role of hair cells.
5. Structure and functions of receptor organs and nervous pathway, Gustatory pathway.

Paper-8B (Practical)
HP- 402M

Full marks-25 (Internal assessment-10; End Sem. Exam. -15)

CONTENTS:

1. Study of Models for anatomical position and functions of organs of brain, eye, ear, nose, tongue.
2. Study and identification of histological slides of brain and spinal cord.
3. Examination of reflexes: Deep reflex (Knee jerk), Superficial reflex (planter reflex).
4. Deafness test: Nerve & conductive deafness -Rinne's and Weber's Test

Suggested Readings:

1. Text book of Medical Physiology, by A.C. Guyton. W.B. Saunders Co.
2. Best & Taylor's Physiological Basis of Medical Practice, O. P Tandon & Y. Tripathi, Lippincott Williams& Wilkins
3. Ganong's Review of Medical Physiology. Barrett et.al, McGraw Hill Lange
4. Harper's Illustrated Biochemistry, V.W. Rodwell and others, Lange
5. Lehninger's Principles of Biochemistry. By D.L. Nelson and M. M. Cox, Worth Publishers Inc.
6. Text Book of Biochemistry, by E.S. West. W.R. Todd. H.S. Mason. J.T. Van Bruggen. The Macmillan Company.
7. Biophysics and Biophysical Chemistry, D. Das. Academic Publishers.
8. Samson Wright's Applied Physiology, C.A. Keele. E Neil & N. Toels. Oxford University Press.
9. Physiology, R.M. Berne & M.N. Levy, C.V. Mosby Co.
10. Basic Histology, L.C. Junqueira & J Carneiro, McGraw- Hill .
11. diFiore's Atlas of Histology, V.P. Eroschenko, Wolters-Kluwer
12. The Cell – A Molecular Approach, G. M Cooper & R. E Hausman, ASM Press SINAUER.
13. Cell Biology, G.Karp, John Wiley & Sons, Inc.
14. Core Text Book of Neuro-Anatomy, by M.B. Carpenter; the Williams and Wilkins Company.
15. The Human Nervous System, by Charles Nobach, Mc Graw Hill Book Co.
16. The Human Nervous System. By M.L. Barr & J.A. Kierman, Harper & Row.
17. Essential Food and Nutrition, by M. Swaminathan. The Bangalore Printing & Publishing Co.
18. Cell & Molecular Biology, EDP De Robertis & EMF De Robertis; Lea & Febiger

19. Molecular Biology of the Gene, by J.D. Watson, H.H. Nancy & others; Benjamin Cummings.
20. Molecular Biology of the Cell, B. Alberts and others, Garland.
21. Textbook of Medical Physiology, Indu Khurana, Elsevier
22. Biochemistry, J. M. Berg, J.L. Tymoczko & L. Stryer, W.H. Freeman
23. William's Text Book of Endocrinology Larsen et. al An Imprint of Elsevier.
24. Endocrinology, Mac E. Hadley, Pearson Education.
25. Vander's Human Physiology, E.P. Widmaier et al., McGraw-Hill, Higher Education.
26. Endocrinology. Vols.I , II and III by L.O. DeGroot. W.B. Saunders Co.
27. Langman's Medical Embryology by J.W. Sadler, Lippincott Williams and Wilkins.\
28. Human Embryology by I. Singh & G. P Pal, McMillan.
29. Statistics in Biology and Psychology by D. Das and A. Das Academic Publishers.
30. An Introduction to Biostatistics, N. Gurumani, M.J.P. Publishers, Chennai.
31. Microbiology, Pelczar Tata McGrawhill.
32. General Microbiology by Stanier et.al, Prentice Hall.
33. Kuby Immunology by T.J Kindt et.al, W.H Freeman.
34. Cellular and Molecular Immunology, A.K. Abbas et.al, Elsevier.



Tripura University
(A Central University)

Course Structure of Human Physiology (UG Programme)

As per NEP-2020 under Tripura University

HUMAN PHYSIOLOGY INTERDISCIPLINARY

HUMAN PHYSIOLOGY INTERDISCIPLINARY

HP-101ID

Total Marks-100 (IA=40+ESE=60)

Credit-3

HP-1st Semester IDC

Unit-I The Unit of life

1. Basic concept of cell>Tissue>Organ>System.
2. Description of cell and its components, functional morphology of cell
3. Ion channels, receptors, carriers, and intercellular communication
4. Human muscular and skeletal system
5. Basic concept of homeostasis and homeostatic control

Unit –II Blood and Cardiovascular system

1. Blood- its components and function
2. Components of circulatory system : heart-structure and function, blood vessels,
3. Cardiac cycle and Cardiac Output
4. Blood Pressure-its regulation, Hypertension

Unit-III:- Respiratory System

1. Respiratory System-its components, structure of lungs
2. Mechanism of Respiration
3. Regulation of Respiration
4. Lung Volumes and Capacity

Unit-IV:- Neurophysiology-

1. Nerve, Muscle and Neuro-Muscle Physiology
2. Organisation of nervous system-receptors and synapse
3. Sensory and motor nervous systems
4. Fundamental physiology of vision
5. Fundamental physiology of audition

HP301ID
HP Interdisciplinary Courses (IDC)
3rd Semester
Total Marks-100 (IA=40+ESE=60)
Credit-3

Unit-I:- Physico-chemical Principles and Chemistry of Biomolecules

1. Diffusion, Osmosis, Osmotic Pressure, Hypo and Hypertonic Solution
2. Acid, Base, pH, Buffers-Definition and Biological Significance
3. Chemistry, Classification of Carbohydrates, Proteins and Fats
4. Protein Purification Techniques
- 5.

Unit-II:- Digestive System and Nutrition

1. Anatomy and Histology of elementary Tract and Digestive Glands
2. Composition and Function of Salivary, Gastric, Pancreatic, Intestinal Juices and Bile
3. Digestion and Absorption of Carbohydrates, Proteins and Fats
4. Physiology of Deglutation and Defecation and Physiological Function

Unit-III:- Metabolism

1. Carbohydrate Metabolism- Glycolysis, Pentose Phosphate Pathway (PPP), Glycogenesis, Neoglucogenesis, TCA Cycle
2. Lipid Metabolism- Fatty Acid Biosynthesis, Beta Oxidation
3. Protein Metabolism-Deamination, Transamination, Urea Cycle
4. Nucleic Acid Metabolism- Catabolism of Purine and Pyrimidine, Gout

Unit-IV:- Nutrition

1. Concept of Nutrients
2. Water Soluble Vitamins-source, requirement, deficiency syndrome
3. Fat Soluble Vitamins- source, requirement, deficiency syndrome
4. Bulk and Trace Elements-Physiological roles and Deficiency syndromes, PCM, Hypervitaminosis, Anaemia, Goitre, Obesity

HP401ID
HP Interdisciplinary Courses (IDC)
HP-4th Semester IDC
Total Marks-100 (IA=40+ESE=60)
Credit-3

Unit I- Endocrinology

1. Pituitary gland- Hormones secreted from anterior and posterior pituitary, physiological functions, hypo and hyperpituitarism.
2. Thyroid gland- Chemical nature and functions of thyroxine, goitre.
3. Adrenal gland- Functions of adrenal cortical and medullary hormones.
4. Endocrine pancreas- Insulin, glucagon, regulation of blood sugar.

Unit II- Reproductive physiology

1. Puberty and menarche- Physiology and hormonal changes.
2. Male reproductive physiology- Anatomical consideration, histology of testis, spermatogenesis- role of hormones.
3. Female reproductive physiology- Anatomical consideration, histology of ovary, oogenesis, menstrual cycle.
4. Fertilization, placenta, parturition, pregnancy test, infertility, IVF.

Unit III- Excretory system

1. Anatomy and histology of kidney, structure of nephron.
2. Basic mechanism of urine formation.
3. Production of hypertonic and hypotonic urine.
4. GFR- Factors affecting it, juxtaglomerular apparatus and extra excretory functions of kidney.

Unit IV- Environmental physiology & public health issues

1. Air, water and noise pollution- Different pollutants and their effects on environment and health, preventive measures.
2. Food additives and preservatives- effects on health, heavy metal, toxicity, causes and effects of radiation.
3. Causes and prevention of communicable diseases- Influenza, malaria, Dengue, Cholera, Hepatitis, HIV.
4. Vaccination, national immunization programmes, Neonatal and child care, basic health and hygiene education.

4th year with research

Paper- 17(Theory)

HP-701C

Total Mark=100(IA = 40+ESE =60) Credit= 04

Unit-I(MetabolicBiochemistry-I)

1. Glycolysis, Gluconeogenesis,
2. Pentosephosphate pathway
3. Glycogenesis and glycogenolysis
4. TCA cycle, Energetics of glycolysis and TCA cycle
5. Cori cycle

Unit-II(MetabolicBiochemistry-II)

1. β -oxidation of fatty acids and Ketone body metabolism.
2. Biosynthesis of fatty acids,
3. Cholesterol synthesis and functions
4. Lipoproteins-VLDL, LDL, HDL.

Unit-III(MetabolicBiochemistry-III)

1. Amino acids- Amino acid pool, Amination, Deamination, Transamination and Decarboxylation. energy producing role of amino acids
2. Catabolism of amino acids, Urea cycle.
3. Integration of major metabolic pathways of energy metabolism.
4. Inborn error of metabolism. Glycogen storage disease, phenyl ketonuria, albinism.
5. Catabolism of purine and pyrimidines. Disorders of purine and pyrimidine metabolism.

Unit-IV(MetabolicBiochemistry-IV)

1. Gibbs free energy, free energy changes and redox potentials, High energy compounds.
2. Electron transport chain, components and reactions of the electron transport chain.
3. Oxidative phosphorylation-mechanism-different hypothesis: chemo-osmotic hypothesis.
4. Structural and functional aspects of F₀, F₁ ATPase, Inhibitors of oxidative phosphorylation; uncouplers.

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Paper 18A (Theory)
HP-702C
Total Mark = 60 (IA = 24+ESE =36) Credit=02

Unit-I (Nutrition & Dietetics-I)

1. Nutritional importance and dietary requirements of carbohydrate, proteins and fat.
2. BMR–definition and determination, factors affecting BMR and its significance.
3. Calorific values of food, Biological value of protein, RQ, SDA and RDA.
4. Complete and incomplete proteins, biological value of proteins, essential amino acids and fatty acids.

Unit-II (Nutrition & Dietetics-II)

1. Food groups, basis and formulation of balanced diet for Growing child. Adult man and Women. Pregnant and Lactating mother. Superfood.
2. Dietary Fibre; Recommended intake of fibre.
3. Glycemic Index(GI);Factors affecting GI of foods; GI in chronic diseases. Pro-biotics- concept and benefits
4. Different types of diets and their uses- Vegetarian, Ovo-vegetarian, Vegan, Ketogenic, DASH.

Unit-III (Nutrition & Dietetics-III)

1. Types, chemical nature and structure of Vitamins,
2. Vitamins-sources, daily requirements, deficiency symptoms and functions.
3. Malnutrition-factors contributing to malnutrition over nutrition, PEM
4. Minerals and trace elements–iron, zinc, magnesium, calcium and iodine: physiological functions, source, requirements, deficiency symptoms.

Unit-IV (Nutrition & Dietetics-IV)

1. Nutritional status: assessment of nutritional status; objectives and goals of assessment of nutritional status.
2. Methods of dietary assessment- direct and anthropometric assessment.
3. Diet therapy for diarrhea, constipation, chronic kidney

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disease.

4. Principles of diet therapy and therapeutic nutrition during-Obesity, Diabetes mellitus, hypertension. Intermittent fasting.

Paper-18B(Practical)

HP- 702C

Total Mark=40(IA = 16+ESE=24)Credit=02

1. Glucose estimation by Titrimetric method.
2. Glucose estimation by colorimetric method (Folin-Wu Method).
3. Estimation of cholesterol by Zak's method
4. Anthropometric Nutritional assessment-MUAC and Head and Chest Circumference. Anthropometric obesity indices- BMI, WHR, WTR, Waist Circumference, Weight-for-age, Height-for-age
5. Study of diet chart as per age group and gender.
6. Study of diet chart for obesity, pregnant and lactating women.
7. Study of diet chart in metabolic disease – Hypertension and Diabetes mellitus.

Paper-19 (Theory)

HP-703C

Total Mark = 100 (IA=40+ESE=60) Credit=04

Unit-I (Embryology and Developmental Biology-I)

1. Introduction to Developmental Biology. Mechanisms of cell differentiation, and morphogenesis.
2. Embryonic stem cells and their signal pathways.
3. Molecular basis of sex determination, aging and senescence.
4. Developmental disorders. Down's syndrome, Turner's syndrome, Klinefelter's syndrome. Teratogenicity.
5. Genetic control of different genes related to development.
6. Stem Cells: basic concept, potentials,
7. Ultrastructure of egg and sperm, Spermatogenesis and Oogenesis and its regulation.
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Unit-II (Embryology and Developmental Biology-II)

1. Early embryonic development: fertilization, cleavage, gastrulation and axis formation.
2. Formation of germ layers: Derivatives of germ layers.
3. Placentation and Extra embryonic Membranes.
4. Foetal Circulation.
5. Organogenesis- Brain, Heart and Liver

Unit-III (Stress Physiology-I)

1. ROS generation in the body-mechanism
2. Role of superoxide dismutase catalase. Glutathione in oxidative stress physiology.
3. High altitude physiology: Barometric & partial pressure of oxygen at high altitude, changes in the body in high altitude
4. Motion sickness, acclimatization to high altitude.

Unit-IV (Stress Physiology-II)

1. Aviation Physiology- Accelerative and gravitational force
2. Effect of positive and negative G force on body.
3. Space physiology-Effects of weightlessness on Cardiovascular system, musculoskeletal system, blood, immune system
4. Space motion sickness.

Paper 20A

(Theory) HP-704C

Total Mark = 60 (IA =24+ESE=36) Credit=02

Unit-I (Neurochemistry)

1. Concept of neurotransmitter,
2. Classification-Inotropic, metabotropic, fast, slow.
3. Structure, subtype and functions of different neurotransmitter receptors (Acetyl choline, catecholamines, glutamate, GABA etc.)
4. Mechanism of action of neurotransmitters, co-transmitters.
5. Circadian rhythm of Hormonal secretion; Biological Clock.

Unit-II (Behavioral Physiology, Higher brain functions & Chronobiology)

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1. Functions of specific cortical areas- Wernicke's area and Broca's area, association areas (Sensory, Motor, Visual, Auditory) Prefrontal cortex and its functions.
2. Higher functions of brain: –learning, memory, classification of memory, molecular basis of memory-consolidation of memory. Disorders of learning and memory- Amnesia, Dementia, Alzheimer's disease.
3. Neurophysiology of language and speech, Speech disorder-Aphesis. Physiological basis of Sleep, Electrical activities of brain. Sleep disorder.
4. Behavioral functions of hypothalamus and associated limbic structures. Importance of reward and punishment centers, fear and rage phenomenon.
5. Idea of Cognition. Cognitive neuroscience and artificial intelligence.

Unit III (Pharmacology)

1. Definition of drug – agonist and antagonist, Drug receptor interaction, Drug delivery
2. Pharmacokinetics – Definition, drug absorption, distribution, metabolism and excretion, bioavailability of drugs
3. Pharmacodynamics – Principles and mechanism of drug action- (anaesthetics, CNS Stimulant, Neuromuscular blockers, β -blockers, Proton pump blockers), factors affecting drug action, dose response curve
4. Biological half life of drug and its significance
5. Drug-drug interaction – concept

Unit IV (Toxicology)

1. Toxins and toxicology – Definition, factors affecting toxicity
2. Effects of toxic compounds in food chain (DDT and Mercury), Bioaccumulation, Bio-magnification.
3. Physiological responses against toxicities of lead, arsenic, organophosphate, carbamates, organochlorine. Detoxification-role of liver.
4. Various types of dose responses relationships – LD50, ED50 and therapeutic index.

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CONTENTS:

1. Chart/ model study-different embryological phases.
2. Placenta model study-normal and abnormal.
3. Effect of temperature and pH on enzyme action.
4. Recording of self/subject heart rate at different time intervals (24h scale) and preparation of curve.
5. Demonstrate the effect of adrenaline, acetylcholine, nicotine, calcium and potassium on perfused heart of toad.
6. Problem based Pharmacology-Calculation of half-life ($T_{1/2}$) of different drugs.
7. Problem based Toxicology- Exposure calculation (Avg, Daily Intake) of Lead, arsenic.

Paper-21(Theory) HP-801C
Total Mark=100(IA = 40+ESE =60) Credit= 04

Unit-I (Microbiology-I)

1. Structure & morphological classification of bacteria, virus & fungi. Classification of virus, bacteriophage life cycle,
2. Bacterial conjugation, transduction & transformation.
3. Bacterial growth curve: different phases, factors affecting growth curve, Bacterial biofilm, composition and function
4. Control of microbial growth: Physical and Chemical methods used in sterilization, disinfection and pasteurization.
5. Different types of antibiotics & their mode of action, mechanism of antibiotic resistance. Antiviral drugs and their mode of actions.

Unit-II (Microbiology-II)

1. Host pathogen interaction: Recognition and entry processes of different pathogens like bacteria, viruses into animal host cells, alteration of host cell behavior by pathogens.
2. Pathophysiology of some common diseases –Bacterial disease-Typhoid, Parasitic disease - malaria, Viral disease- HIV
3. Food microbiology: Beneficial and harmful microorganisms in food. Fermentation- Principle and types; Glyoxalate cycle.
4. Elementary knowledge for production of fermented milk products (Cheese, dahi), alcohol.
5. Industrial Microbiology : Industrial Antibiotic production-Penicillin, citric acid. Concept of waste management using microbes.

Unit-III (Environmental Physiology)

1. Definition, scope, and significance of environmental physiology; Different environmental pollutants effecting human health.
2. Air, Water and Noise pollution; Effects of Ionizing and non-ionizing radiations.
3. Global warming, ozone depletion, greenhouse effect, carbon footprint.
4. Passive smoking and its physiological effects. Bio-monitoring and biomarkers of environmental exposure.
5. Environmental stressors and cellular responses to environmental stress. Role of antioxidants.

Unit-IV (Public Health)

1. Food safety and food hygiene-basic idea, Malnutrition in a community, over-nutrition and possible remedial measures. Diet management of obese, diabetic, hypertensive individuals and athletes. Iron and iodine deficiency.

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2. Population problem- principles and methods of family planning, Problem of infertility and Assisted Reproductive Technologies.
3. PCM - Marasmus, Kwashiorkor, Marasmic Kwashiorkor, endemic goiter, nutritional anemia, rickets, osteomalacia, xerophthalmia, beriberi and their social implications. Immunization against diseases.
4. Etiology and prevention of communicable diseases –Malaria, Cholera, Dengu, Hepatitis, HIV. Etiology and prevention of non-communicable diseases-Hypertension, Obesity, Diabetes.
5. Age-related physiological changes, Dementia awareness, osteoporosis. Elderly nutrition

Paper 22 (Research)
HP- Theory
 (Biostatistics, Research Methodology)
Credit =4+8= 12

Unit-I (Biostatistics-I)

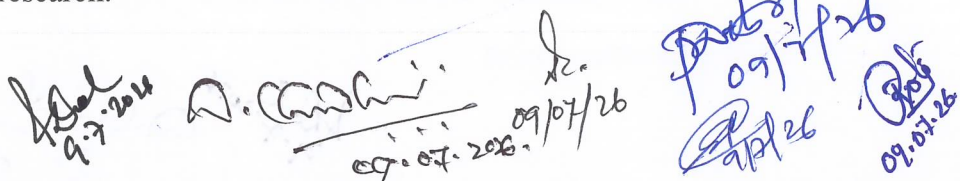
1. Principles of statistical analysis of biological data.
2. Basic concepts of variables, population and sampling.
3. Different classes of statistics- mean, median, mode, mean deviation, variance, standard deviation, standard error of mean.
4. Degrees of freedom, probability, normal distribution.
5. Graphs and Scientific Figures- Bar charts, Pie charts, Line graphs, Scatter plots, Histograms.

Unit-II (Biostatistics-II)

1. Testing of hypothesis– Null hypothesis, errors of inference, level of significance
2. t-test- Paired and unpaired, Chi-square test, one way ANOVA.
3. Correlation coefficient–linear correlation and linear regression.
4. Introduction to Computers in Research- Components of a computer (hardware and software), Operating systems, Types of software used in scientific research, Advantages of computer-based research.
5. Computer Applications in Research- Literature search, Online databases, Data entry and storage, Data management, Scientific writing, Reference management, Research communication.

Unit-III (Research Methodology & Ethical issues in Biomedical Research)

1. Research methodology: Meaning of research, objectives and significance of research, types of research.



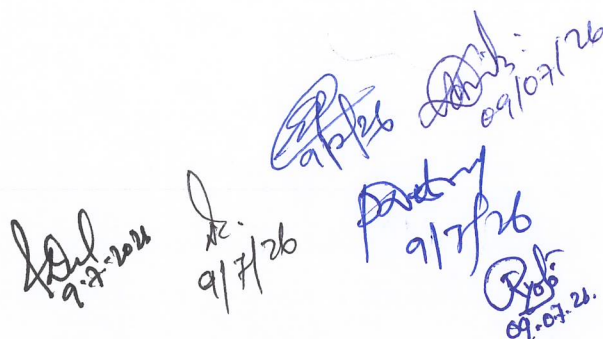
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2. Scientific methods in research, selecting a research problem, importance of formulating a research problem.
3. Steps in formulating a research problem, Developing hypothesis and research objectives. Research design, Need for research design, the concept of sampling, aims in selecting a sample, types of sampling, sample design and its different steps.
4. Need for basis of selecting a sampling procedure, characteristics of a good sample design, types of data. Ethical Issues in Data collection: Ethics-concept, Ethical issues to consider concerning research participants. Ethical justification for animal experimentation.
5. Reporting: Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Precautions for Writing Research Reports & submission of research report.

Unit-IV (Biological Techniques)

1. Spectrophotometry-working principles. Lamda max.
2. Recombinant DNA technology: restriction endonuclease, Cloning vector
3. Cloning of DNA into cloning vectors. Southern blotting, northern blotting, Western blotting, PCR, RIA, ELISA
4. Microscopy: Scanning Electron Microscopy and Transmission Electron Microscopy- their applications in cell biology. Fluorescence microscopy, Basics about tissue fixatives, embedding and tissue section processing for staining; types of staining
5. Patch-clamp technique

Research (Dissertations) 12 credit



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4th Year B.Sc. without research

Paper- 17(Theory) HP-701C

Total Mark=100(IA = 40+ESE =60) Credit= 04

Unit-I(MetabolicBiochemistry-I)

1. Glycolysis, Gluconeogenesis,
2. Pentosephosphate pathway
3. Glycogenesis and glycogenolysis
4. TCA cycle, Energetics of glycolysis and TCA cycle
5. Coricyle

Unit-II(MetabolicBiochemistry-II)

1. β -oxidation of fatty acids and Ketone body metabolism.
2. Biosynthesis of fatty acids,
3. Cholesterol synthesis and functions
4. Lipoproteins-VLDL, LDL, HDL.

Unit-III(MetabolicBiochemistry-III)

1. Aminoacids- Aminoacid pool, Amination, Deamination, Transamination and Decarboxylation. energy producing role of amino acids
2. Catabolism of amino acids, Urea cycle.
3. Integration of major metabolic pathways of energy metabolism.
4. Inborn error of metabolism. Glycogen storage disease, phenyl ketonuria, albinism.
5. Catabolism of purine and pyrimidines. Disorders of purine and pyrimidine metabolism.

Unit-IV(MetabolicBiochemistry-IV)

1. Gibbs free energy, free energy changes and redox potentials, High energy compounds.
2. Electron transport chain, components and reactions of the electron transport chain.
3. Oxidative phosphorylation-mechanism-different hypothesis: chemo-osmotic hypothesis.
4. Structural and functional aspects of F₀, F₁ ATPase, Inhibitors of oxidative phosphorylation; uncouplers.

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Paper 18A (Theory) HP-702C

Total Mark = 60 (IA = 24+ESE =36) Credit=02

Unit-I (Nutrition & Dietetics-I)

1. Nutritional importance and dietary requirements of carbohydrate, proteins and fat.
2. BMR—definition and determination, factors affecting BMR and its significance.
3. Calorific values of food, Biological value of protein, RQ, SDA and RDA.
4. Complete and incomplete proteins, biological value of proteins, essential amino acids and fatty acids.

Unit-II (Nutrition & Dietetics-II)

1. Food groups, basis and formulation of balanced diet for Growing child. Adult man and Women. Pregnant and Lactating mother. Superfood.
2. Dietary Fibre; Recommended intake of fibre.
3. Glycemic Index(GI); Factors affecting GI of foods; GI in chronic diseases. Pro-biotics- concept and benefits
4. Different types of diets and their uses- Vegetarian, Ovo-vegetarian, Vegan, Ketogenic, DASH.

Unit-III (Nutrition & Dietetics-III)

1. Types, chemical nature and structure of Vitamins,
2. Vitamins-sources, daily requirements, deficiency symptoms and functions.
3. Malnutrition-factors contributing to malnutrition over nutrition, PEM
4. Minerals and trace elements-iron, zinc, magnesium, calcium and iodine: physiological functions, source, requirements, deficiency symptoms.

Unit-IV (Nutrition & Dietetics-IV)

1. Nutritional status: assessment of nutritional status; objectives and goals of assessment of nutritional status.
2. Methods of dietary assessment- direct and anthropometric assessment.
3. Diet therapy for diarrhea, constipation, chronic kidney disease.
4. Principles of diet therapy and therapeutic nutrition during-Obesity, Diabetes mellitus, hypertension. Intermittent fasting.

Paper-18B(Practical) HP- 702C
Total Mark=40(IA = 16+ESE=24)Credit=02

1. Glucose estimation by Titrimetric method.
2. Glucose estimation by colorimetric method (Folin-Wu Method).
3. Estimation of cholesterol by Zak's method
4. Anthropometric Nutritional assessment-MUAC and Head and Chest Circumference.
Anthropometric obesity indices- BMI, WHR, WTR, Waist Circumference,
Weight-for-age, Height-for-age
5. Study of diet chart as per age group and gender.
6. Study of diet chart for obesity, pregnant and lactating women.
7. Study of diet chart in metabolic disease – Hypertension and Diabetes mellitus.

Paper-19 (Theory) HP-703C
Total Mark = 100 (IA=40+ESE=60) Credit=04

Unit-I (Embryology and Developmental Biology-I)

1. Introduction to Developmental Biology. Mechanisms of cell differentiation, and morphogenesis.
2. Embryonic stem cells and their signal pathways.
3. Molecular basis of sex determination, aging and senescence.
4. Developmental disorders. Down's syndrome, Turner's syndrome, Klinefelter's syndrome. Teratogenicity.
5. Genetic control of different genes related to development.
6. Stem Cells: basic concept, potentials,
7. Ultrastructure of egg and sperm, Spermatogenesis and Oogenesis and its regulation.
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Unit-II (Embryology and Developmental Biology-II)

1. Early embryonic development: fertilization, cleavage, gastrulation and axis formation.
2. Formation of germ layers: Derivatives of germ layers.
3. Placentation and Extra embryonic Membranes.
4. Foetal Circulation.
5. Organogenesis- Brain, Heart and Liver

Unit-III (Stress Physiology-I)

1. ROS generation in the body-mechanism
2. Role of superoxide dismutase catalase. Glutathione in oxidative stress physiology.
3. High altitude physiology: Barometric & partial pressure of oxygen at high altitude, changes in the body in high altitude
4. Motion sickness, acclimatization to high altitude.

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Unit-IV (Stress Physiology-II)

1. Aviation Physiology- Accelerative and gravitational force
2. Effect of positive and negative G force on body.
3. Space physiology-Effects of weightlessness on Cardiovascular system, musculoskeletal system, blood, immune system
4. Space motion sickness.

Paper 20A (Theory) HP-704C

Total Mark = 60 (IA =24+ESE=36) Credit=02

Unit-I (Neurochemistry)

1. Concept of neurotransmitter,
2. Classification-Inotropic, metabotropic, fast, slow.
3. Structure, subtype and functions of different neurotransmitter receptors (Acetyl choline, catecholamines, glutamate, GABA etc.)
4. Mechanism of action of neurotransmitters, co-transmitters.
5. Circadian rhythm of Hormonal secretion; Biological Clock.

Unit-II (Behavioral Physiology, Higher brain functions & Chronobiology)

1. Functions of specific cortical areas- Wernicke's area and Broca's area, association areas (Sensory, Motor, Visual, Auditory) Prefrontal cortex and its functions.
2. Higher functions of brain: -learning, memory, classification of memory, molecular basis of memory-consolidation of memory. Disorders of learning and memory- Amnesia, Dementia, Alzheimer's disease.
3. Neurophysiology of language and speech, Speech disorder- Aphesis. Physiological basis of Sleep, Electrical activities of brain. Sleep disorder.
4. Behavioral functions of hypothalamus and associated limbic structures. Importance of reward and punishment centers, fear and rage phenomenon.
5. Idea of Cognition. Cognitive neuroscience and artificial intelligence.

Unit III (Pharmacology)

1. Definition of drug – agonist and antagonist, Drug receptor interaction, Drug delivery
2. Pharmacokinetics – Definition, drug absorption, distribution, metabolism and excretion, bioavailability of drugs

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3. Pharmacodynamics – Principles and mechanism of drug action- (anaesthetics, CNS Stimulant, Neuromuscular blockers, β -blockers, Proton pump blockers), factors affecting drug action, dose response curve
4. Biological half life of drug and its significance
5. Drug-drug interaction – concept

Unit IV (Toxicology)

1. Toxins and toxicology – Definition, factors affecting toxicity
2. Effects of toxic compounds in food chain (DDT and Mercury), Bioaccumulation, Bio-magnification.
3. Physiological responses against toxicities of lead, arsenic, organophosphate, carbamates, organochlorine. Detoxification-role of liver.
4. Various types of dose responses relationships – LD50, ED50 and therapeutic index.

Paper-20B (Practical) HP- 704C

Total Mark=40(IA = 16+ESE=24) Credit=02

CONTENTS:

1. Chart/ model study-different embryological phases.
2. Placenta model study-normal and abnormal.
3. Effect of temperature and pH on enzyme action.
4. Recording of self/subject heart rate at different time intervals (24h scale) and preparation of curve.
5. Demonstrate the effect of adrenaline, acetylcholine, nicotine, calcium and potassium on perfused heart of toad.
6. Problem based Pharmacology-Calculation of half-life ($T_{1/2}$) of different drugs.
7. Problem based Toxicology- Exposure calculation (Avg, Daily Intake) of Lead, arsenic.

Paper- 21 (Theory) HP-801C

Total Mark=100 (IA = 40+ESE =60) Credit= 04

Unit-I (Microbiology-I)

1. Morphological classification of bacteria, virus & fungi, parasites and protozoa.
2. Structure of bacterial cell wall, difference between bacterial & fungal cell wall, LPS layer, Structure of pili, flagella, spores and cysts- functions.

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3. Classification of virus, bacteriophage life cycle.
4. Bacterial conjugation, transduction & transformation.
5. Bacterial biofilm, composition and function

Unit-II (Microbiology-II)

1. Bacterial growth curve: Difference phase, factors affecting growth curve, significance of difference phase of bacterial growth curve.
2. Control of microbial growth: Physical and Chemical methods used in sterilization, disinfection and pasteurization.
3. Pathological agents, transmission, prevention of gastrointestinal infection in Cholera.
4. Pathological agents, transmission, prevention of respiratory infections in Influenza.
5. Pathological agents, transmission, prevention in Rabies.

Unit-III (Microbiology-III)

1. Different types of antibiotics & their mode of action, mechanism of antibiotic resistance.
2. Antiviral drugs and their mode of actions
3. Host parasite interaction: Recognition and entry processes of different pathogens like bacteria, viruses into animal host cells.
4. Alteration of host cell behavior by pathogens.
5. Pathophysiology of some common diseases –Bacterial disease-Typhoid, Parasitic disease - malaria, Viral disease- HIV.

Unit-IV (Food and Industrial Microbiology-IV)

1. Food microbiology: Beneficial and harmful microorganisms in food, causative organisms of food-borne infections (Shigella, Clostridium)- mode of transmission and methods of prevention.
2. Bacterial metabolism : Fermentation- Principle and types and Glyoxalate cycle.
3. Industrial Microbiology : Elementary knowledge for production of fermented milk products (Cheese, dahi), alcohol.
4. Industrial Antibiotic production-Penicillin, citric acid. Preliminary idea about the production of vaccines from microbes.
5. Concept of waste management using microbes.

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Paper 22A (Theory)
HP-802C-Environmental Physiology & Public Health Issues
Total Mark = 60 (IA = 24 + ESE = 36) Credit =02

Unit-I (Environmental Physiology)

1. Definition, scope, and significance of environmental physiology
2. Different environmental pollutants effecting human health. Acclimatization versus adaptation.
3. Air, Water and Noise pollution.
4. Sources and effects of Chlorinated hydrocarbons on human body.
5. Environmental stressors and cellular responses to environmental stress.

Unit-II (Environmental Physiology)

1. Effects of Organo-phosphorus and Organo-carbamates compounds on human system.
2. Bio-monitoring and biomarkers of environmental exposure.
3. Effects of Ionizing and non-ionizing radiations.
4. Global warming, ozone depletion, greenhouse effect, carbon footprint.
5. Passive smoking and its physiological effects.

Unit-III (Public Health Issues)

1. Basic idea about community & public health issues.
2. Malnutrition in a community, over-nutrition and possible remedial measures. Diet management of obese, diabetic, hypertensive individuals and athletes. Iron and iodine deficiency.
3. Population problem- principles and methods of family planning, Problem of infertility and Assisted Reproductive Technologies.
4. PCM - Marasmus, Kwashiorkor, Marasmic Kwashiorkor.
5. Endemic goiter, nutritional anemia, rickets, osteomalacia, xerophthalmia, beriberi and their social implications. Immunization against diseases.

Unit-IV (Public Health Issues)

1. Food safety and food hygiene
2. Etiology and prevention of communicable diseases –Dengu, Hepatitis, Tubercuolosis, measles, chicken pox.
3. Etiology and prevention of non-communicable diseases- Hypertension, Obesity, Diabetes.
4. Age-related physiological changes, Dementia awareness, osteoporosis. Elderly nutrition.
5. Disaster preparedness : First aid and CPR. Public health management during disasters.

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Paper- 22B (Practical)

HP- 802C

Total Mark =40(IA =24+ESE=16)Credit=02

CONTENT: Review Writing

Paper-23 (Theory)

HP-803C

Cell Biological, Molecular Biological & Immunological Techniques

Total Mark = 100 (IA = 40 + ESE = 60)

Credit = 04

Unit-I (Cell Biological Techniques)

1. Microscopy: Optical microscope and phase contrast microscope- their basic principles. Scanning Electron Microscopy and Transmission Electron Microscopy- their applications in cell biology.
2. Fluorescence microscopy, Advantages of confocal microscopy.
3. Principles applications of Fluorescent Activating Cell Sorting(FACS)
4. Basics about tissue fixatives, embedding and tissue section processing for staining; types of staining.

Unit-II (Molecular Biological Techniques-I)

1. Electrophoresis-general principle, native and SDS-Polyacrylamide gel electrophoresis.
2. Principles of chromatography-Gel-exclusion, Ion-exchange, affinity chromatography.
3. Spectrophotometry-working principles. Lamda max.
4. DNA and protein sequencing.

Unit-III (Molecular Biological Techniques-II)

1. Recombinant DNA technology: restriction endonuclease, DNA cloning,
2. Cloning vector- plasmid and phage vectors, cloning of DNA into cloning vectors.
3. DNA probe, Colony hybridization, Southern blotting, northern blotting, Western blotting.
4. Principle of Polymerase chain reaction(PCR)

Unit-IV (Immunological Techniques)

1. Immunoprecipitation,
2. Radio-immunoassay,
3. Enzyme Linked Immuno Sorbant Assay (ELISA)-direct, indirect.
4. Monoclonal and Polyclonal antibody development, Hybridoma technology.

Paper 24A (Theory)

HP-804C

Biostatistics, Research Methodology

Total Mark=60 (IA=24+ESE=36) Credit =02

Unit-I (Biostatistics I)

1. Principles of statistical analysis of biological data.
2. Basic concepts of variables, population and sampling.
3. Different classes of statistics- mean, median, mode, mean deviation, variance, standard deviation, standard error of mean.
4. Degrees of freedom, probability, normal distribution.
5. Graphs and Scientific Figures- Bar charts, Pie charts, Line graphs, Scatter plots, Histograms.

Unit-II (Biostatistics II)

1. Testing of hypothesis- Null hypothesis, errors of inference, level of significance
2. t-test- Paired and unpaired, Chi-square test, one way ANOVA.
3. Correlation coefficient-linear correlation and linear regression.
4. Introduction to Computers in Research- Components of a computer (hardware and software),
Operating systems, Types of software used in scientific research, Advantages of computer-based research.
5. Computer Applications in Research- Literature search, Online databases, Data entry and storage,
Data management, Scientific writing, Reference management, Research communication.

Unit-III (Research Methodology & Ethical issues in Biomedical Research)

1. Research methodology: Meaning of research, objectives and significance of research, types of research.
2. Scientific methods in research, selecting a research problem, importance of formulating a research problem.
3. Sources of research problems, survey and review of literature, the formulation of research objectives.
4. Developing hypothesis and verifying concepts, research design, defining the population & selecting the sample, choice of methods.

Unit-IV (Research Methodology & Ethical issues in Biomedical Research)

1. Need for research design, the concept of sampling, aims in selecting a sample, types of sampling, sample design and its different steps.
2. Need for basis of selecting a sampling procedure, characteristics of a

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3. Types of research, fundamental or basic research, applied or practical research, Experimental research, Lab experiments and field experiments, Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation.
4. Reporting: Significance of Report Writing, Different Steps in Writing Report, Layout of the Research , Plagiarism check & submission of research report..

CONTENT: Project Work

4th YEAR
Semester-VII
Paper-7A(Theory)
HP- 701M

Full marks-60 (Internal assessment-24;End Sem.Exam.-36)

Unit-1:Endocrinology-I

1. Concept of autocrine, paracrine and endocrine system. Anatomical organization of endocrine glands.
2. Hypothalamic releasing factors. Hypothalamo- hypophyseal portal system
3. Histology of pituitary gland. Anterior and posterior pituitary gland hormones and their functions.
4. Hypo and hyper secretion of pituitary hormones.

Unit-2:Endocrinology-II

1. Thyroid and parathyroid glands histology, hormones and their functions.
2. Adrenal gland-histology, hormones and their functions.
3. Pancreas-histology, hormones and their functions.
4. Diabetes mellitus-types.

Unit-3:Reproductive Physiology-I

1. Anatomical organization of male and female reproductive organs.Primary and accessory sex organs and secondary sex characters.
2. Physiology of puberty.
3. Histology of testis. Endocrine functions of testis.
4. Spermatogenesis and its regulation
5. Histology of ovary.Ovarian hormones and their functions. Oogenesis.

Unit-4:Reproductive Physiology-II

1. Menstrual cycle
2. Fertilization and Implantation.
3. Physiology of Parturition.
4. Physiological changes during pregnancy. Pregnancy test.
5. Contraceptive methods and methods of artificial reproduction (IVF)

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Paper-7B(Practical)

HP- 701M

Fullmarks-40(Internal assessment-16; End Sem.Exam.-24)

CONTENTS:

1. Study of Models for anatomical position and functions of organs of endocrine glands and reproductive system
2. Study and identification of histological slides of endocrine glands and reproductive system.
3. Study of Charts on—Spermatogenesis and oogenesis.

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Semester-VIII
Paper-8A(Theory)
HP-801M

Fullmarks-60(Internalassessment-24;EndSem.Exam.-36)

Unit-1: Nerve -Muscle Physiology

1. Structure, properties and classification of Neurons and Neuroglia.
2. Resting membrane potential (RMP).Action potential(AP), ionic basis, characteristics of AP, propagation in different types of nerve fibers.
3. Synapse, structure and transmission of nerve impulse through synapse. Neuromuscular Junction (NMJ)-structure, motor unit, propagation of nerve impulse through the neuro-muscular junction.
4. Receptors, classification, types, Reflex, arc, classification.
5. Structure of skeletal muscle. Mechanism of skeletal muscle contraction.

Unit-2:Nervous System-I

1. Introduction to Nervous system. Structural organization of brain and spinal cord.
2. CSF and functions of CSF. Blood Brain Barrier.
3. Somato-sensory system: Ascending (sensory) tracts-carrying touch, pain, temperature sensation.
4. Motor system: Descending tracts (pyramidal and extra pyramidal systems), Upper motor and lower motor neurons and their lesions.
5. Hemi section and complete section at different levels of spinal cord. Brown sequard syndrome.

Unit-3:Nervous System-II

1. Autonomic Nervous system (ANS): Classification, structural and functional organizations. Neurotransmitter in ANS.
2. Thalamus: Nuclei, functions. Thalamic animal. Thalamic syndrome.
3. Hypothalamus: Nuclei, functions: Feeding & satiety, Thermoregulation etc.
4. Cerebellum: Histology, nuclei, connections and functions.
5. Basal ganglia: structure connections and functions

Unit-4: Special senses

1. Vision: anatomy and structure of different layers of eye ball, cornea, lens, aqueous and vitreous humor.

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2. Histology of retina and transmission of light signal. Functions of iris, lachrymal gland secretion and functions.
3. Visual Pathway, Myopia and hypermetropia, color blindness, Mechanism of development of cataract, glaucoma.
4. Mechanism of hearing and role of hair cells. Organ of corti, auditory pathway.
5. Olfaction and gustation: Structure and functions of receptor organs, nerve pathways, centers.

Paper-8B(Practical)

HP- 402M

Fullmarks-25(Internalassessment-10;EndSem.Exam. -15)

CONTENTS:

1. StudyofModels for anatomicalpositionand functionsoforgansofbrain, eye, ear, nose, tongue.
2. Studyandidentificationofhistologicalslidesofbrainand spinalcord.
3. Examinationofreflexes:Deepreflex(Kneejerk), Superficialreflex(planterreflex).
4. Deafnesstest:Nerve&conductivedeafness-Rinne'sandWeber'sTest

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