VIDYASAGAR UNIVERSITY

PHYSIOLOGY

(Honours & General)

Under Graduate Syllabus

(3 Tier Examination Pattern)

w.e.f. 2014-2015

REVISED

Vidyasagar University

Midnapore 721 102

West Bengal

PHYSIOLOGY

(HONOURS)

PART-I
(One year course)

Paper- I (Theory): 100 Marks.

Unit- 01: 50 Marks	**Lectures**
i) Cell Biology and Structural Units of Human Systems	20
ii) Tissue Organization and Basic Anatomy of Human Body	10
iii) Biophysical and Biochemical Principles	15
iv) Blood and Body Fluids.	30

Unit-02: 50 Marks

i) Chemistry of Bio-molecules	30
ii) Enzymology	25
iii) Techniques in Studying Physiology	20

Paper II (Theory): 100 Marks

Unit-03: 50 Marks

i) Nerve-Muscle Physiology	35
ii) Cardio-Vascular Physiology and Circulation	40

Unit-04: 50 Marks

i) Respiratory System	30
ii) Digestive System	25
iii) Renal Physiology	20

PART-II

(One year course)

Paper-III (Theory): 100 Marks **Lectures**

Unit-05: 50 Marks

i)	Nervous System	45
ii)	Skin and Body Temperature Regulation	15
iii)	Pharmacological Physiology	15

Unit 06: 50 Marks

i)	Sensory Physiology	45
ii)	Work Physiology, Sports Physiology and Ergonomics	30

Paper-IV (Theory): 100 Marks **Lectures**

Unit-07: 50 Marks

i)	Metabolism of Bio-molecules	30
ii)	Nutrition and Dietetics	25
iii)	Social Physiology and Community Health	20

Unit-08: 50 Marks

i)	Microbiology	25
ii)	Immunology	35
iii)	Environmental Physiology	15

Paper -V (Practical): Full Marks 100 **Distribution of Marks**

A.	Histology	45
i)	Staining and examination of fresh tissues	10
ii)	Staining and identification of supplied paraffin sections	15
iii)	Identification of stained permanent slides	10
iv)	Haematology	10

B. Biochemistry	35
i) Qualitative identification (one sample)	10
ii) Quantitative analysis	10
iii) Analytical biochemistry	15
C. Laboratory Note Books	10
D. Viva-Voce	10

PART-III
(One year course)

Paper-VI (Theory) 100 Marks — **Lectures**

Unit-09: 50 Marks

i) The Endocrine System and Chronobiology	40
ii) Reproductive Physiology	25
iii) Embryology	10

Unit-10: 50 Marks

i) Genetics and Molecular Biology	30
ii) Applied Biotechnology	25
iii) Bio-Statistics and Concept of Computer	20

Paper-VII (Practical): 100 Marks — **Distribution of Marks**

A. Experimental Physiology	15
B. Human Experiment and Anthropometric Measurements	20
C. Computer Application	10
D. Project Work / Field Survey (Preparation 15 + Viva-Voce 10)	25
E. Educational Excursion	10
F. Laboratory Note Books	10
G. Viva-Voce	10

Paper-VIII (Practical): 100 Marks

A. Environmental Physiology	10
B. Microbiology	10
C. Clinical Physiology	10
D. Blood Biochemistry	20
E. Biostatistics	10
F. Biotechnology	10
G. Diet Survey	10
H. Laboratory Note Books	10
I. Viva-Voce	10

PHYSIOLOGY
(HONOURS)

PART-I

(One year course)

PAPER-I

UNIT - 01: **50 Marks**

i) Cell Biology and Structural Units of Human Systems:

Electron microscopic structure and functions of the organelles of eukaryotic cells: Structure of plasma membrane - Bio-chemical components, their arrangement, membrane asymmetry and fluidity; Functions; Fluid mosaic model. Membrane transport: active and carrier mediated transport; Mechanism of exocytosis and endocytosis. Structure functions and control of ion channels. Artificial membrane: liposome and its functions. Endoplasmic reticulum: EM structure and functions (Molecular basis) of smooth and rough ER. Microsomes: basic functional aspects. Golgi complex: structure, its storage and processing functions (Molecular basis). Lysosomes and its functions. EM structure and functions of nucleus. Peroxisomes and its function. Mitochondria: EM structure and its functions. EM structure of nucleus-structure of nuclear membrane and nucleolus. Ribosomes – cytoribosomes and mitoribosomes; their structure and functions. Cytoskeleton: structure and its role in stabilization of cell shape. Microtubules and their role in cellular movements and secretions. Events of Cell cycle; Cell differentiation; Gap junction, Tight junction (structure and functions); Cell adhesion molecule (brief).

(20 lectures)

ii) Tissue Organization and Basic Anatomy of Human Body:

Structure, classification, distribution and functions of different tissues. Organization of different organs and systems of the human body. **(10 lectures)**

iii) Biophysical and Biochemical Principles:

Law of mass action, orders of reactions, properties of water. Significance and physiological application of the following phenomena: diffusion, osmosis, dialysis,

surface tension, viscosity, adsorption, absorption. Colloids: properties and significances, sol and gel, lyophilic and lyophobic sol, electrokinetic properties; Isoelectric pH and isoelectric precipitation. Gibbs-Donnan membrane equilibrium and its biological importance. Acids and bases as proton donors and acceptors. Conjugate acid-base pairs; pH: definition, explanation, determination and significance; Buffers: definition, types; functions of buffers. Role of kidney, erythrocyte and lungs for maintaining body pH. Indicators and its applications. First and second laws of thermodynamis, closed and open system, living body as a thermodynamic system, entropy, enthalpy, maintenance of physiological steady state. Gibbs concept of free energy. **(15 lectures)**

iv) Blood and Body Fluids:

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

Composition and function of Blood. Plasma proteins: Classification, normal value, origin and functions, Plasmapheresis. Erythrocytes: Morphology, fate and functions; Steps of erythropoiesis, role of different factors on erythropoiesis. Hemoglobin: chemistry, biosynthesis, functions, catabolism; derivatives like oxyhemoglobin, methemoglobin, carboxyhemoglobin and hemin. Abnormal hemoglobin: thalassemia, sickle cell anemia. Normal value and clinical significane of ESR, TC, DC, PCV, MCH, MCHC, MCV. Anemia: megaloblastic and microcytic, pernicious, aplastic, hypo-chromic. Polycythemia. Blood groups: ABO system; Rh-antigens, blood transfusion and its hazards. Blood group incompatibility- erythoblastosis fetalis. Leucocytes: Morphology, classification, life cycles, functions. Significance of Arneth count, Schilling index, reticulocyte count. Platelet- Morphology, life cycles, functions. Significance of platelet count. Haemostasis Coagulation factors, mechanism of blood coagulation:, disorders of coagulation; anticoagulants (natural and artificial) and their mode of action, coagulation time, bleeding time, prothrombin time, hemolysis.

Blood volume: Normal values, determination by dye method and isotope method and factors influencing blood volume. Regulation of blood volume.

Lymph and tissue fluid: Anatomical organization of lymphatic system. Formation, composition, circulation, functions and fate of lymph and tissue fluid. **(30 lectures)**

UNIT - 02: **50 Marks**

i) Chemistry of Bio-molecules:

Carbohydrates: Definition and classification.

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

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

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

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

Amino acids and Proteins:

Amino acids: Classification, Structure, Nomenclature and Optical properties. Protonic equilibrium of amino acids - amphoteric nature, Zwitterions, Isoelectric point, titration curve of amino acids. Reactions with ninhydrin and formaldehyde.

Peptides and Proteins: Structure and properties of peptide bonds - Phi and Psi angles. Reactions with Sanger's and Edman's reagent. Biuret reaction. Different levels of protein structure - Primary, Secondary (α-helix and β- pleated sheet), Tertiary and Quarternary. Forces stabilizing the structures (Covalent bonds, Ionic and hydrogen bonds, Van-der-Waals forces and hydrophobic interactions). Denaturation and Renaturation reactions.

Purine and Pyrimidine: Structure, nomenclature and tautomerism.

Nucleic acids: Nucleosides and Nucleotides - structure. Polynucleotides. DNA double helix - Primary, Secondary and Tertiary structure. A-DNA, B-DNA and Z-DNA. RNA - Structure and types. Denaturation and annealing of DNA. Hyperchromicity, melting temperature and half $C_o t$ value. **(30 lectures)**

ii) **Enzymology** –

Definition, chemical nature, classification and nomenclature. Mechanism of enzyme action - active site, specificity and enzyme-substrate complex formation. Enzyme kinetics: Hyperbolic kinetics and linear transformation (Lineweaver-Burk Plot; *Eisenthal Cornish-Bowden Plot*). Michaelis - Menten constant. Effect of temperature, pH and metal ions on enzyme activity. Allosteric enzyme- Definition, properties, and types; Sigmoid kinetics. Regulation of enzyme activity - Allosteric modulation; Feedback and feed forward regulations; Covalent modification; Inhibition: Reversible- competitive, non-competitive and uncompetitive inhibition; Irreversible inhibition. Coenzyme and prosthetic groups; Activation of pro enzymes. Isoenzymes. Rate limiting enzymes. Ribozymes, Abzymes, Antizymes, Synzymes. Fundamental ideas about immobilized enzyme. Enzymes in clinical diagnosis (amylase, acid and alkaline phosphatase, SGOT, SGPT, LDH and CPK). **(25 lectures)**

iii) Techniques in Studying Physiology:

Basic principle and use of light, phase contrast, electron microscopy, atomic force microscopy and fluorescence microscopy. Spectrophotometer. Principle of chromatography, ion exchange, gel filtratiom, GLC, TLC and immune-affmity chromatography. Electrophoresis: SDS-PAGE and agarose gel. Cell fractionation: Homogenization and ultrasonication, Ultracentrifugation, Differential and density gradient centrifugation for separation of cell fractions. Radio activity - use of radio isotopes in physiological studies.

Principle and uses of biomedical instruments - USG, Endoscopy, X-ray, MRI, CT-scan, Hemodialysis, Artificial pacemaker. **(20 lectures)**

PAPER-II

UNIT - 03: **50 Marks**

i) Nerve-Muscle Physiology:

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

The resting membrane potential and its origin. The Action Potential - components and its ionic basis. Compound action potentials. Concept of Chronaxie and Rheobase. Saltatory

conduction. Myelinated and Unmyelinated nerve fibers and process of Myelinogenesis. Propagation of nerve impulse in different types of nerve fibers. Conduction velocity of nerve impulse in relation to myelination and diameter of nerve fibers. Properties of nerve fibers: Excitability, Conductivity, All-or-none law, Accommodation, Adaptation, Summation, Refractory period, Indefatigability. Synapses: Types and EM Structure-Function. Mechanism of Synaptic Transmission of the impulse, Synaptic Potentials (EPSP, IPSP) and neurotransmitters. Structure and distribution of accetylcholine and adrenaline receptors. Injury to peripheral nerves- Degeneration and Regeneration of peripheral nerve fibers: Changes in the nerve cell body, reaction of degeneration and mechanism of regeneration. Effect of different Neurotrophins on nerve growth.

(35 lectures)

ii) Cardio-Vascular Physiology and Circulation:

Basic properties of cardiac muscle: rhythmicity, refractory period, all or none law, and stair case phenomenon. Transmembrane potential, pacemaker potential and electro-physiology of cardiac tissue. Specialized junctional tissue of the heart and origin and propagation of cardiac impulse. Understanding of cardiac muscle as mechanical, electrical and functional syncytium. Heart block and basic idea about artificial pacemaker. Electrocardiography- Origin and significance of different components of normal ECG; Different types of ECG leads; Einthoven triangle. Principle of Echo-cardiography. Cardiac valves: Location and functions. Heart rate and its regulation. Cardiac cycle: Different phases and pressure changes in cardiac chambers. Frank – Starling's law of heart. Heart sounds: Their origin and significance. Cardiac output: Definition, normal values and factors regulating it, Determination by Fick method, dye dilution method and isotope method. Nerve supply of the heart and its role in the regulation of the function of the heart.

Blood pressure: Definition, normal values and factors regulating it, systolic, diastolic, mean arterial and pulse pressure. Measurement of blood pressure by sphygmomanometer - principle, method. Central pulse and peripheral pulse and their patterns. Venous pulse, Regulation of blood pressure: Innervations of blood vessels and vasomotor control, vasomotor reflex; role of baroreceptors and chemoreceptors, neural and humoral control. Role of renin-angiotensin system. Vasopressin or ADH in BP regulation. Anatomical

organization, peculiarities and significance of coronary, pulmonary, cerebral, cutaneous, hepatic and renal circulation. **(40 lectures)**

UNIT-04: **50 Marks**

i) Respiratory System:

Basic concepts about respiratory tract, histology of lungs, respiratory muscles and their innervations. Mechanism of respiration and the role of different respiratory and accessory muscles. Compliance, elasticity and elastic recoil of the lung. Role of lung surfactants. Intra-thoracic and intra-pleural pressures. Tidal volume, inspiratory and expiratory reserve volumes, residual volume, vital capacity, functional residual capacity, maximum breathing capacity. Partial pressures and percentage of respiratory gases in inspired, expired, alveolar airs and in blood. Respiratory gases and their exchange between the lung alveoli and blood and between the blood and the tissues. Transport of O_2 and CO_2 in blood. O_2 dissociation curve, CO_2 dissociation curve and factors affecting. Modern concept of regulation of respiration: Role of respiratory centers, central and peripheral chemoreceptors. Respiratory failure, artificial respiration and its different techniques (mouth to mouth, tank respirator method). Hypoxia, asphyxia, dyspnea, asthma, cardiac and bronchial emphysema, cyanosis, dysbarism, coughing and sneezing. Lung function tests. Non respiratory functions of lung - Airway defence, Immune system defence and biosynthetic functions. **(30 lectures)**

ii) Digestive System:

Histology and functions of digestive organs - tongue, pharynx, esophagus, stomach, small intestine, large intestine, pancreas, liver, gall bladder and salivary glands. Nerve supply to the alimentary system. Mechanism, functions and regulation of mastication, deglutition, movement of the alimentary canal. Composition, functions, mechanism of secretion and control of saliva, gastric juice, pancreatic juice, bile and intestinal juice. Mechanism and control of gastric HCl secretion. Functions of gall bladder and large intestine. Mechanism and importance of Enterohepatic circulation of bile. Brief idea about gall stones, achlorhydria, hyperchlorhydria, peptic ulcer, Pavlov's pouch, defecation reflex, vomiting reflex. **(25 lectures)**

iii) Renal Physiology:

Gross structure of kidney. Microanatomy (including electron microscopy) of a nephron and structural differences between cortical and Juxtamedullary nephrons. Juxtaglomerular apparatus. Mechanism of urine formation: Concept of ultrafiltration, glomerular filtration rate, reabsorption by passive and active tubular transport. Concept of counter current system, countercurrent multiplier, exchanger and mechanism of concentrated urine formation. Non-excretory functions of kidney. Normal and abnormal constituents of urine and their clinical significance. Concept of renal threshold. Renal function tests (inulin, urea clearance tests). Renal stone formation. Dialysis and artificial kidney. Innervations of urinary bladder and micturition, micturition reflexes and its regulation by higher centers. **(20 lectures)**

PART-II
(One- year course)

PAPER-III

UNIT-05: **50 Marks**

i) The Nervous System:

Organization: A brief outline of the organization and basic functions of the nervous system – central and peripheral. Structural organization of the different parts of brain and spinal cord. Receptors: Definition, Structure, Classification, Mode of action. Role of blockers and stimulators (Drugs included in pharmacology). Reflex action: Definition, classification, properties. Structure and functions of the spinal cord with special reference to functional changes after hemi section and complete section of spinal cord, Brown-Sequard syndrome. Ascending and descending tract: Origin, courses, termination and functions. Lower motor neuron and upper motor neuron. Structure and function of vestibular apparatus. Postural reflexes, Muscle spindle, muscle tone and its regulation. Decerebrate and decorticate rigidity. Structure, connections and functions of cerebellum. Nuclei, connections and functions of thalamus and hypothalamus. Basal ganglia: structure, connections and functions. Cerebral cortex: histological structure, connections and functions. Organization of limbic system and its functions. Emotion. Origin and components of EEG. Physiological basis of different types of sleep. Sleep-wakefulness cycle. Higher functions of nervous system: memory, conditioning and learning. Speech and aphasias. Physiology of pain. CSF: formation, circulation and functions.

Autonomic nervous system: Organization, outflow, ganglia, centers and functions. Chemical transmission in autonomic nervous system; Nicotinic and muscarnic acetyl choline receptors, alpha and beta adreno-receptors and their agonists and antagonists. Central control of autonomic nervous system for regulation of internal body homeostasis.

(45 lectures)

ii) Skin and Body Temperature Regulation:

Histological structure of skin. Organization of sweat gland. Composition and functions of sweat. Regulation of sweat secretion. Insensible and sensible perspiration. Composition and functions of sebum. Triple response.

Normal body temperature. Channels of heat loss and heat gain process of heat production and heat loss. Regulation of body temperature: higher centers and mechanism of regulation. Hypothermia and hyperthermia. Physiological basis of fever. **(15 lectures)**

iii) Pharmacological Physiology:

The importance of pharmacology in the study of physiological processes. Drugs, Agonist, Antagonist. Pharmacokinetics- absorption, distribution, excretion and bioavailability of drugs. Pharmacodynamics-Drug biotransformation and mechanism of drug action (elementary idea). The dose effect relationship and the characteristics of dose response curve. Assessment of drug toxicity - LD50 and ED50. Drugs affecting synaptic and neuro-effector functional sites – Chemistry, systemic effects and mechanism of action of phenoxybenzamine, phentolamine and propranolol. Drugs affecting catecholamine and cholinergic neuro-transmission – guanethidine, reserpine, physostigmine and isoflurophate. Neuromuscular blocking agents-tubocurarine, succinyl choline, nicotine. Sedative- hypnotics: Barbiturates- actions on organ systems and mechanism of action. Narcotic analgesics: Pharmacological properties and mechanism of action. Antihistamine: Pharmacological properties. Diuretics: Effects on renal functions and mechanism of action of benzothiadiazides. **(15 lectures)**

UNIT-06: 50 Marks

i) Sensory Physiology:

Classification of general and special senses and their receptors. Muller's law of specific nerve energies. Weber-Fechner law. Mechanism of transduction of stimuli from sensory receptors. Adaptation of receptors-phasic and tonic adaptations.

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

Olfaction and Gustation: Structure and functions of the receptor organs, nerve pathways, centers. Physiology of taste and smell. Olfactometer.

Audition: Sound waves, decibel, structure and functional significance of auditory apparatus – external, middle and internal ears. Structure of organ of corti. Mechanism of hearing and its modern theories. Discrimination of sound frequency and loudness. Auditory pathway and centers.

Vision: Anatomy and structures of the eyeball. The structures of lens. Errors of refraction and their corrections. Contact Lens. Pupillary reflexes, light reflex, near response. Argyll Robertson pupil. Histological details of retina. Photopic and Scotopic vision. Chemical and electrical changes in retina on exposure to light. Visual Pathway and effects of lesion. Colour visions and its modem concept. Colour blindness. Electroretinogram. Visual field, Perimetry. Visual acuity and its measurement. Factors affecting Visual Acuity. Binocular vision and depth perception. **(45 lectures)**

ii) Work Physiology, Sports Physiology and Ergonomics:

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

Elementry idea of ergogenic aids. Physical training - general principles and different methods. Nutrition in sports - nutrients and calorie requirements for different kinds of sports. Anthropometry – common instruments for anthropometric measurements. Application of anthropometry in nutrition and ergonomics. Basic concepts of ergonomics and its application in industry to increase individual and group productivity. Work-rest cycle. Industrial safety, Occupational hazards – Physical Bio-chemical hazards. Occupational diseases - Silicosis, Asbestosis, Farmer's lung. **(30 lectures)**

PAPER-IV
UNIT-07: 50 Marks

i) Metabolism of Bio-molecules

Digestion and absorption of carbohydrates, lipid, proteins and nucleoproteins.

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

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

Lipid Mechanism: β-oxidation of saturated fatty acids (Palmitic acids), ω and α oxidation. Biosynthesis of saturated fatty acid (C_{16}). Formation and sphingomyelin. Brief concept of cholesterol biosynthesis and its physiological significance. Metabolism of adipose tissue. Role of lipoproteins in transport and storage of lipids.

Amino Acids Metabolism: Glucogenic and ketogenic amino acids and amino acid pool. Non protein nitrogen. Trans-amination, oxidative and non-oxidative deaminations. Ammonotelic, ureotelic and uricotelic organisms. Metabolism of glycine, sulphur containing amino acids, tryptophan and tyrosine, Synthesis of specialized products from amino acids (viz., catecholamines, creatine phosphate, nicotinamide, histamine, serotonin and melatonin, melanin, gamma-aminobutyrate, taurine and glutathione). Inborn errors of metabolism of trytophan, phenylalanine and tyrosine. One carbon metabolism, labile methyl group and transmethylation. Synthesis of Urea and Nitric oxide.

Reactive Oxygen Species: Formation of Reactive Oxygen Species and the role of Catalase, Superoxide Dismutase, Glutathione Peroxidase and Glutathione Reductase in combating oxidative stress. Role of vitamins as antioxidants.

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

Mineral metabolism: Sodium, potassium, chloride, calcium and phosphorus metabolism. Trace elements (iron, iodine, fluorine, selenium) - their functions and deficiencies. **(30 lectures)**

ii) Nutrition & Dietetics:

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

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

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

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

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

Energy in Human Nutrition: Basic concept of energy and units, calorific and physiological fuel value, respiratory quotient (RQ), Total energy expenditure (TEE), Basal metabolic rates (BMR) and Resting energy expenditure (REE), Specific dynamic action (SDA), physical activity ratio (PAR), Determination of BMR by Benedict Roth apparatus and WHO/ICMR prediction equation, Factors affecting BMR, Adult

consumption unit (ACU), determination of energy requirements of Indians in different age groups by doubly labeled water (DLW) method and prediction equation method.

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

Space Nutrition: change of body composition, energy recommendation for space flights, space food system, types of space foods. **(25 lectures)**

iii) Social Physiology and Community Health:

Basic Concept: Demography, Society and Community. Factors affecting Community Health, Direct and Indirect Nutritional Assessment of Human Individual and Community (Steps- Diet History, Nutritional Anthropometry, Dietary Survey, Clinical Examinations, Biochemical and Radiological assessment, Mortality rates, and Morbidity rates).

Nutritional Problem in Community: Malnutrition, Undernutrition, Kwashiorkor, Marasmus, Marasmic Rickets, Osteomalacia, Xeropthalmia, BeriBeri, Pellagra, Nutritional Anemia, Dental Caries, Endemic Goiter. Nutritional Deficiencies in pregnancy and remedial measures. Dietary Management for coronary heart disease, Diabetes mellitus. Diets of Renal Disorders, Obesity and Cancer.

Causes, pathogenesis and Preventions of Some Communicable Diseases: cholera, measles, pox, tuberculosis, malaria, HIV and poliomyelitis. Composition, functions and uses of ORS.

National Nutrition Related Health Programmes: Vit. A Prophylaxis Programme, Anemia Prophylaxis Programme, ICDS, Mid Day Meal Programme. Human Breast milk Composition, its requirement and benefits. Colostrum. **(20 lectures)**

UNIT-08: 50 Marks

i) Microbiology:

Organization of prokaryotic cell. Classification of bacteria on the basis of morphology, staining characteristics, biochemical tests and 16S rRNA test for identification. Nutritional requirements of bacteria, nutritional types, culture media. Sterilization - types, principles and importance. Pasteurization and its application. Concept of pure culture and different methods of pure culture technique. Bacterial growth curve and physical conditions for growth, Bacterial metabolism: fermentation (ethanol, lactic acid, acetic acid), glyoxylate cycle, Entner-Doudoroff pathway, phosphoketolase pathway. Bacterial genetics: elementary idea of transformation, conjugation and transduction. Control of bacterial growth: concept of antiseptics, disinfectants, antibiotics, probiotics and prebiotics. Elementary idea of bacteriostatic, bactericidal and bacteriolytic agents. Food microbiology – Brief ideas about food spoilage (fish, meat, milk, vegetables) and its prevention. Industrial Microbiology: Elementary knowledge for production of fermented products like alcohol, glutamic acid, penicillin and milk products (cheese, dahi). Environmental Microbiology: Role of microbes in Bio-geo chemical cycle (brief). Elementary knowledge of fungus, algae, protozoa, and virus. **(25 lectures)**

ii) Immunology:

Overview of Immune System - properties of immune system; types of immunity: innate immunity, acquired immunity, active and passive immunity. First and second line defence.

Immuno-competent Cells- Structure and functions of Neutrophil, B-lymphocytes, T-lymphocytes (helper, cytotoxic and suppressor), Natural killer cells, monocytes-macrophages. Primary and secondary lymphoid organs.

Antigen-Antibody: Properties of immunogen, antigens and haptens. Classification, structure and functions of immunoglobqlins (IgG, IgM, IgA, IgD, IgE). Antigen antibody interaction, their physiological effects and clinical applications.

Major Histocompatibility Complex: Elementary ideas about Human leucocyte antigens. Self, Non-self. Antigen processing and presentation with MHC (Class I and II).

Biology of B-lymphocyte: Elementary idea of B-Cell receptors (IgM, Igα/Igβ , CD 19, Cr2/CD21) and activation (in brief).

Biology of T-lymphocyte: Elementary idea of T-Cell receptors (TCR, CD28/l52, CD40L) and. activation of T-cell (in brief):

Humoral immunity: Primary and secondary immune responses. Mechanisms of humoral immunity- Cooperation of T cells B cells and macrophages for the production of specific antibody. Role of cytokines in humoral immunity. Antibody diversity (in brief).

Cytokines: Types and functions.

Complements: Classification, components, activation of pathways (classical, alternative and lectin) and functions.

Cell mediated immunity: Generation and activation CTLs; Effector molecules and mechanism of cytolytic effects. NK cells and their mechanism of killing. Antibody dependent cell mediated cytotoxicity.

Innate immunity: Mechanical barrier against pathogenic organism, Physiological barrier-antibacterial and antifungal substances in external body secretions, bactericidal action of HCl. Mechanism of chemotaxis, phagocytosis-role of lysozyme and reactive oxygen species. Inflammation: mechanism and effects of inflammation. Role of cytokines in inflammatory response. Toll like receptor (in brief)

Hypersensitivity reactions: Mechanism of different types of hypersensitivity reactions and their physiological effects.

Transplantation immunology: Types of graft; Immunological basis of graft rejection; mechanism involved in graft rejection; clinical manifestation of graft rejection.

Autoimmunity: Immunological features of autoimmune diseases. Mechanism of autoimmune diseases of thyroid, kidney and muscles.

Acquired Immunodeficiency: AIDS, The HIV virus & infection; immunological events associated with HIV infection.

Immunization: Concept about immunization, Immunizing agent- vaccine, antisera, DNA vaccine, edible vaccine. Immunization schedules - National and WHO. Hazards of immunization.

Immunological techniques - Principle of Immunoassay, ELISA, RIA and immunoelectrophoresis. Role ELISA and RIA in Hormone assay. **(35 lectures)**

iii) Environmental Physiology:

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

(15 lectures)

PART-III
(One-year course)
P APER- VI

UNIT -09: 50 Marks

i) Endocrine System and Chronobiology:

Concept & Definition of endocrine systems, glands and hormones. Experimental and clinical methods of study of endocrine glands. General classification of hormones on chemical basis. Concepts of hormone receptors and cell signalling. Mechanisms and Modern Concept of hormone actions: G-protein, Cyclic AMP, cyclic GMP, IP_3-DAG, Ca^{2+}, Tyrosine Kinase, JAK-STAT pathway and nuclear receptor mediated action.

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

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

Thyroid Gland: Electron microscopic structure of thyroid gland. Thyroid hormone: Chemistry, Biosynthesis, Storage and Transport. Functions of T_4 (Thyroxin) and T3 (Triiodothyronine). Regulation of Thyroid hormone secretion. Cretinism. Myxedema, Grave's disease. Hashimoto's disease, iodine deficiency goiter.

Parathyroid Gland: Histological Structure, Parathyroid hormone: Role in calcium metabolism. Relation of parathyroid hormone with bone formation and bone resorption, fragile bone and aging process, Concept of Vitamin D_3 treatment. Calcitonin: its source, functions and regulation. Hormonal control of calcium homeostasis.

Adrenal Cortex: histological structure, regulation different types of hormones and functions of adrenal cortex, Cushing's syndrome, Addison's disease, Hyperaldosteronism.

Adrenal Medulla: Histological structure, regulation and hormonal function of adrenal medulla. Synthesis and metabolism of catecholamine hormones. Actions of adrenaline and nor-adrenaline on different organs and their effect. Pheochromocytoma.

Pancreas: Histological structure of pancreatic islets. Sources, regulation, modes of action and functions of insulin and glucagon, Type-l and Type-II diabetes mellitus.

Gastrointestinal hormones (Gastrin, Secretin, Cholecystokinin, VIP and GIP)- Physiological functions.

Endocrine Role of the Pineal. ANF and its functions.

Chronobiology: Different types of physiological rhythms- ultradian, circadian, infradian. Different zeitgebers and their relation with circadian rhythm. Biorhythms of LH, FSH, Prolactin, Estrogen, Progesterone, ACTH GH, Cortisol. Light dark cycle and regulation of penial hormone. Neural basis of biological clock and the role of suprachiasrnatic nuclei. Brief idea of jet-lag. **(40 lectures)**

ii) Reproductive Physiology:

Primary and secondary sex organs: Physiology and anatomy, secondary sex characters. Puberty and its control.

Testis: Histological structure of testis, seminiferous tubules and interstitial cells of Leydig. Chemical nature and functions of testosterone. Spermatogenesis, Spermiogenesis and hormonal control of testicular function. Prostate and seminal vesicle.

Ovary: Histological structure of ovary, Graafian follicle and Corpus luteum, chemical nature and functions of Estrogen and Progesterone. Hormonal control of ovarian functions. Menstrual cycles and its hormonal control. Formation, Maturation of Ovum. Physiological Mechanism of Ovulation. Basic concepts of ovarian cysts. Estrous cycle.

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

Lactation and Mammary Gland: Anatomical and Histological structure of mammary gland. Phases of mammary development and their hormonal control. Hormonal control of lactation and milk ejection reflex. **(25 lectures)**

iii) Embryology

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

(10 lectures)

UNIT -10: 50 Marks

i) Genetics and Molecular Biology:

Chromosome structure: Concept of nucleosome, molecular organization, chromosomal proteins, the different levels of chromatin organization. Double helical structure and Watson Crick model of DNA. Basic concept of DNA replication: Meselson and Stahl Experiment, DNA Polymerases, Ligases and other regulatory proteins. Brief idea of DNA damage and repair. Structure of different RNA molecules and mechanism of transcription of RNA (prokaryotic). Elementary idea of gene, genetic code, Wobble hypothesis and mechanism of translation (prokaryotic). Elementary idea about regulation of gene expression - operon concept, lac operon, lytic and lysogenic cycle of phage (Brief). Chromosomal aberration and gene mutations (agents and types). Idea about human genome project. Concept of oncogenes, tumour suppressor genes and properties of cancer cells. **(30 lectures)**

ii) Applied Biotechnology:

Elementary idea of genetic engineering: concept of cloning and its significance, isolation of DNA fragment to be cloned, restriction enzymes, vectors, ligation of DNA to the vector, introduction of recombinant DNA into host cell, screening for recombinant cell. Applications of recombinant DNA technology and gene therapy, Basic concepts of Southern, Northern, Western blot techniques and DNA micro-array. Fermentation

technology. Fermentation: types (submerged and solid state), bioreactors and its operation, types of microbes, raw materials and downstream processing. Production of human insulin, interferons, vaccines (hepatitis). Production, application and utility of monoclonal antibodies. Concept of single cell proteins, biofuels, bioremediation, biofilters, biopesticides (BT cotton, Alkaloids of *Azadirachta indica* (neem), Pheromone, Baculovirus), bioplastic, biosensors and biochips. Concept of genetically modified organisms, transgenic goats, cattle and chickens. Bio-safety and Intellectual property rights. Elementary idea about bio-informatics, genomics and proteomics. **(25 lectures)**

iii) Biostatistics and Concept of Computer:

Definition and classification of statistics. Defmition of population, parameter and sample. Sampling methods. Frequency distribution & frequency polygon, histogram, bar-diagram, pie diagram. Mean, median, mode and the methods of their computation, merits, demerits and applications. Variance, standard deviation, standard error of mean and their computation. Normal probability distribution. Students t-distribution. Skewness, Kurtosis, Null-hypothesis, errors of inference, level of significance, two tail and one tail 't' test for significance of difference between sample means. Chi-square test. Linear correlation: product moment correlation coefficient, Spearman's p (rho).

Computer: Basic concepts of software, hardware and types of computer. Computer packages: concept of MS Word, Excel, power point. Concepts of networking and web site, computer virus. **(20 lectures)**

Framing of questions and distribution of marks in each unit of theoretical question papers:

1) Five short answer type questions are to be answered from eight questions of two marks each. **(10 marks)**
2) Four semi-long answer type questions are to be answered from six questions of 5 marks each. **(20 marks)**
3) One long answer type question is to be answered from two questions of 15 marks each which will be subdivided into two components: 8 marks and 7 marks.

PRACTICAL
PAPER – V

A. **Histology: 45 Marks** **(10 marks)**

i) Staining and Examination of fresh tissues:
Squamous, ciliated, columnar epithelium (methylene blue), corneal cell space (silver nitrate), mesentry (silver nitrate), urinary bladder (silver nitrate), node of Ranvier (silver nitrate), adipose tissue (Sudan III or IV), voluntary muscle (methylene blue). Specimens should be taken strictly from Goat / Rat.

ii) Tissue preparation, section cutting, staining and submission of five histological slides duly signed by teacher. **(5 marks)**
Liver, Kidney, intestine, tongue, testis, ovary, lung, spleen, salivary gland, pancreas.

iii) Staining and identification of supplied paraffin sections of mammalian tissues (Eosine and Hematoxylene stain). **(10 marks)**
Liver, kidney, esophagus, duodenum, ileum, large intestine, lungs, spleen lymph node, ovary, testis, salivary glands, thyroid, adrenal, pancreas, spinal cord, cerebellum, cerebrum.

iv) Study and identification of stained sections of different mammalian tissues and organs. **(10 marks)**
Bone, cartilage, trachea, lung, spleen, lymph gland, tongue, esophagus, stomach, duodenum, ileum, jejunum, large intestine, liver, kidney, salivary glands, pancreas, adrenal gland, thyroid gland, testis, ovary, uterus, spinal cord, cerebral cortex, cerebellum, skin, cardiac muscle, skeletal muscle, smooth muscle, artery, vein.

v) Hematology **(10 marks)**

Preparation of hemin crystal. Determination of coagulation time by capillary method. Bleeding time (Dukemethod), Blood grouping, Rh typing. Preparation and staining of human blood film (Leishman); Identification and measurement of WBC. Differential count of WBC, Arneth count, platelet. count, total count of RBC and WBC. Staining of reticulocyte. Estimation of hemoglobin (visual method) and cyanmethaemoglobin

method. Determination of hematocrit value, calculation of red blood cell indices (MCV, MCH and MCHC). Study of bone marrow for identification of megakaryocytes.

B. Biochemistry **(35 Marks)**

i) Qualitative analysis of biochemical molecules: Carbohydrates- Glucose, fructose, maltose/ lactose, sucrose, starch, dextrin. Proteins – Albumin, gelatin, peptone; Others - glycerol, cholesterol, bile salts and pigments, acetone, HCI, lactic acid, urea, uric acid blood. **(One sample - 10 marks)**

ii) Analytical biochemistry **(25 marks)**

Quantitative analysis (l0 marks)

a. Determination of strength of NaOH, HCl and H_2SO_4 by titration against oxalic acid.
b. Preparation of buffer (pH 4 to 10)
c. Quantitative estimation of chloride by Mohr's method, amino nitrogen by formol-titration method.
d. Estimation of free and total acidity in supplied gastric juice.
e. Assay of enzymes and TLC: Determination of optimum pH, temperature, V max and Km value of enzyme (amylase through 3, 5 dinitrosalicylate reagent). Chromatography: Identification of amino acid and sugar through TLC or paper chromatography.
f. Estimation of DNA, RNA and total protein by DPA, Orcinol and Lowry method.

Food stuff analysis (15 marks)

Estimation of lactose and calcium from milk. Determination of total carbohydrate by phenol-sulphuric acid method from cereals. Estimation of free amino acids by ninhydrin method and total protein by quantitative biurette reagent method from pulses. Determination of acid value and iodine number of fat. Estimation of Vit-C from lemon juice.

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

C. Laboratory Note Books: **(10 marks)**

D. Viva-Voce: **(10 marks)**

PAPER- VII

A. Experimental Physiology: 20 Marks

i) Skeletal Muscle: Study and use of kymograph, induction coils, key and tuning fork in Gastrocnemius sciatic preparation. Kymographic recording of isotonic muscle twitch. Effects of temperature, summation and load (after-load) on muscle contraction (Demonstration).

Heart: Kymographic recording of heart beat of toad. Preparation of amphibian Ringer solution. Kymographic recording of perfused heart beat of toad. Study of the effects of acetylcholine and excess calcium ion on perfused heart (Demonstrations).

** Students will be trained to interpret the prepared supplied curve. **(5 marks)**

ii) Small Intestine: Kymographic recording of normal movements of rat's intestine in Dale's apparatus. Effects of anoxia, acetylcholine and adrenaline on normal intestinal movements. **(15 marks)**

B. Human experiments & Anthropometric measurements: 20 Marks

(a) Measurement of arterial blood pressure at rest, after exercise and at different postural conditions by Sphygmomanometer. Harvard step test and determination of physical fitness. Measurement of breathing rate before and after exercise. Determination of VO_2 max by Queen's College method. Study of effect of graded exercise (by Bicycle ergometer/Treadmill) on heart rate. Pneumographic effects of talking, laughing, coughing, exercise, hyperventilation and breath holding. Determination of muscular efficiency by Mosso's ergograph. Spirometric measurement of vital capacity. Determination of hand and foot reaction time. **(10 marks)**

(b) Anthropometric parameters: Weight, stature, eye height, shoulder height, elbow height, bi-acromian breadth, head breadth, head circumference and neck

circumference. Mid upper arm circumference, chest circumference, waist circumference, hip circumference, waist hip ratio, BMI, BSA. **(10 marks)**

C. Computer application: 10 Marks

Operation of MS Word and Excel: Preparation of body text and table by using MS word, Graphical representation of data in pie, bar and line diagram using Microsoft Excel, presentation of study material by using power point.

D. Project / Field study Report: 20 Marks

Performed in a group and maximum 6 students will be in a group.

(Field survey report should be prepared on health related issues). **(Preparation 12+Viva-Voce 8)**

E. Educational Excursion: 10 Marks

A report is to be submitted on the basis of a visit to a Medical college / University / Research Institute. Report should be prepared with proper justification and illustrations. (Report - 06 + Viva-Voce - 04)

F. Laboratory Note Books: 10 Marks

G. Viva-Voce: 10 Marks

PAPER-VIII

A. Environmental Physiology: 10 Marks

i) Measurement of environmental temperature - dry bulb and wet bulb, relative humidity, air velocity.
ii) Determination of O_2, CO_2, BOD and COD. Determination of total alkalinity, Ca, Mg and chlorine in water by titration method,
iii) Measurement of noise by Sound level meter.
iv) Determination of light intensity (at library, laboratory & class room) by lux meter.

B. Microbiology and Biotechnology: 20 Marks

Microbiology: Sterilization, Culture preparation and isolation of bacteria. Biochemical characterization of microorganisms (Biochemical tests – Catalase test, Oxidase test, Fermentation of sugar- Glucose, Lactose, Sucrose, Mannitol, Hydrolysis of Starch, Gelatine, Casein, Citrate and propionate utilization test, Indole production test, Nitrate reduction test, Methyl red test and Voges Proskauer [V. P.] test). Negative staining. Gram staining, Acid-fast staining. Bacterial spore staining. Water portability by MPN method.

Biotechnology: Isolation of DNA (from blood and microbial culture), Isolation of protein, Gel electrophoresis of DNA and protein, Quantification of isolated DNA and protein.

C. Clinical Physiology: 10 Marks

Pregnancy test (slide/strip method), Sperm count, sperm viability test by using eosine-Y, Routine clinical tests of urine. Test for supplied CSF: Globulin (Pandy test), total protein, glucose. Measurement of different waves of ECG, Examination of planter reflex, knee jerk reflex.

D. Blood Biochemistry: 20 Marks

a) Photo-colorimetric estimation of blood constituents:

i) Blood glucose by Nelson-Somogyi method
ii) Blood inorganic phosphate by Fiske - Subbarow method
iii) Serum total protein by Biuret method and determination albumin globulin ratio.
iv) Determination of serum amylase by iodometric method.
v) Serum billirubin by Diazo method.
vi) Serum urea by DAM method.
vii) Blood cholesterol by $FeCl_3$ method
viii) Estimation of acid and alkaline phosphatase, SGOT & SGPT of supplied blood.

E. Biostatistics: 10 Marks

Computation of mean, median, mode, standard deviation, standard error of the mean with physiological data like body temperature, height, weight, heart rate, respiratory rate, blood pressure of human subjects. Student's 't' test and chi-square test for significance of difference between means. Spearman's rank difference correlation coefficient. Chi-square test.

F. Diet Survey: 10 Marks

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

H. Laboratory Note Books: 10 Marks

I. Viva-Voce: 10 Marks

RECOMMENDED BOOKS FOR PHYSIOLOGY (HONOURS) COURSE

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

TEXT BOOKS:

1. Text book of Medical Physiology, by A.C. Guyton, John E. Hall, Eleventh edition. Elsevier Saunders.
2. Vander et al's Human Physiology: The Mechanisms of Body Function; 9th Edition Eric P. Widmaier, Hershel Raff, Kevin T. Strang The Mc Graw-Hill Companies.
3. Human Physiology, From Cells to Systems Lauralee Sherwood, Brooks/Cole.
4. Best & Taylor's Physiological Basis of Medical Practice, edited by B.R Brobeck. The William and Wilkins Co.
5. Ganong's Review of Medical Physiology, by Kim E. Barrett et al., Lange Medical Book.
6. Harper's Review of Biochemistry by R K. Murry and others. Lange Medical Book, Prentice-Hall International.
7. Lehninger Principles of Biochemistry, by, D. L. Nelson and M. M. Cox, CBS Publishers Inc.
8. Text book of Biochemistry, by E.S. West, W.R. Todd, H.S. Mason, J.T. Van Bruggen, The Macmillan Company.
9. Biochemistry, by D. Das: Academic Publishers.
10. Biophysics and Biophysical Chemistry, by D .Das, Academic Publishers.
11. Samson Wright's Applied Physiology, edited by C.A. Keele. E. Neil & N. Toets. Oxford University Press.
12. Physiology, by R.M. Berne & M.N. Levy, B.M. Koeppen, B. A. Stanton, Mosby Co.
13. Basic Histology, by L.C. Jungquire, J. Carneiro & J.A Long; Appleton & Lange.

14. Neuroscience Third Edition Edited By D. Purves, G. J. Augustine, D. Fitzpatrick, W. C. Hall, A S.I. Lamantia, J.O. Mcnamara, S. M Williams, Publishers Sinauer Associates, Inc.
15. Histology - A Text and Atlas, by M.H.Ross & E.J.Reith, The Williams and Wilkins Company.
16. Bailey's Text Book of Histology, revised by W.M. Copenhaver; The Williams and Wilkins Company.
17. Human Physiology, by R.F. Schmidt & G. Thews, Springer-Verlag.
18. Core Text Book ofNeuro-Anatomy, by M.B. Carpenter; The Williams and Wilkins Company.
19. The Human Nervous System, by Charles Nobach, Mc Graw Hill Book Co.
20. The Human Nervous System by M.L.Barr & I.A. Kierman, Harper & Row.
21. Essential Immunology, by I.M. Roitt, Blackwell Scientific Publications.
22. Cellular & Molecular Biology, by E. D. P. De Robertis & E. M. F. De Robertis, Lea & Febiger.
23. Principles of Genetics, Sixth edition, D. Peter Snustad, Michael J. Simmons John Wiley & Sons, Inc.
24. Molecular Biology of the Gene, by J.D. Watson. H.H. Nancy & others; Pearson education.
25. Molecular Biology of the Cell, by B. Alberts and others, Garland.
26. Human Physiology, by Rhoades & Pflanzer, Brooks/Cole.
27. Carleton's Histological Techniques, by R.A.B. Drury & E.A. Wallignton, Oxford University Press.
28. Medical physiology W. F. Boron and E. I. Boulpsep, Elsevier Saunders.
29. Handbook of Experimental Physiology and Biochemistry, by P. V. Chadha; Jaypee Brothers Medical Publishers.
30. Kuby Immunology, by R.A. Goldsby. T.J. Kindt and B.A. Osbome. W H. Freeman and Co.
31. Neurobiology. by G.M. Shepherd, Oxford University Press.
32. Biochemistry, by L. Stryer, WH. Freeman and Co.
33. Molecular Cell Biology, by H. Lodish, D. Baltimore & others, Scientific American Book.
34. Genetics: Analysis of Genes and Genomes, by D.L. Hartl and E. W Jones. Jones & Boolen Publishers.

35. Note Books on Practical Biochemistry, Experimental Physiology and Histology. (published by the Physiological Society of India, Kolkata).
36. Willam's Text Book of Endocrinology by J.D. Wilson and D.W. Foster W.B. Saunders of Co.
37. The Kidney-An outline of Normal and Abnormal Functions by H.E. Dewardeper. ELBS
38. Essential Food and Nutrition. by M. Swaminathan. The Bangalore Printing & Publishing Co. Ltd.
39. Medical Embryology by J. Langman, .Williams & Wilkins.
40. Circadian Rhythms and the Human by D.S. Minors and 1M. Wat~rhouse, Wright, PSG.
41. Clinical Gynecologic Endocrinology and Infertility by L, Speroff, R. H. Glass, N. G. Kase, MacMillan.
42. Text book of Medical Physiology by G. K. Pal, P. Pal, Ahuja Pub. House.
43. Essential Medical Physiology Edited by L R. Johnson, Academic Press:
44. Human Anatomy and Physiology by E. Marieb, Pearson Education.
45. Fundamentals of Biochemistry by Jain and Jain, S. Chand and Com.
46. Biochemistry by U. Satyanarayan, Boks and Allied.
47. Lippincott's Illustrated Reviews: Biochemistry by P. C. Champe et al., Lippincott Williams & Wilkins.
48. Biochemistry by Pankaja Naik, Jaypee Brothers.
49. Physiology by J. Bullck et al Lippincott Williams & Wilkins.
50. Text book of Biochemistry by T. M.Devlin, John Wiley Pub.
51. Fundamentals of Biochemistry by Voet, Voet, and Pratt, John Wiley Pub.
52. Cellular and Molecular Immunology A.K. Abbas and A.H. Lichtman, Elsevier Saunders.
53. Under Standing Immunology by Peter Wood, Pearson Education.
54. Text Book of Biochemistry and Physiology by G. P. Talwar and LM. Stivastava, Prentice Hall of India.
55. Chronobiology Edited by J.C. Dunlap, J.J. Loros, P.J. deCoursey, Sinauer Associates Inc. Pub.
56. Text Book of Physiology by G. H. Bell, J. N. Daviclcon and H. Scarborougl, ELBS.
57. Physiology of Respiration by J.H. Comroe, Year Book Medical Publishers.

58. Text Book of Physiology. Vols. I & II by H. D. Patton. A. F. Fuchs, B. Hille. A. M. Scher and R. Sleiner, W B. Saunders Co.
59. Concise Medical Physiology by S.K. Chaudhury, New Central Book Agency.
60. Medical Physiology by A.B.S. Mahapatra, Current Books International.
61. Endocrinology, Vols. I, II and III by La. DeGroot. W.B. Saunders Co.
62. Essentials of Human Embryology by AK. Das Current Books International.
63. Human Embryology by I.B. Singh, MacMillan India Ltd.
64. The Circadian System of Man by R.A Wever, springer- verlag.
65. The Clocks That Time Us by M. C. Moore - Ede and others, Harvard University Press.
66. The Physiological Clock: Circadian Rhythms and Biological Chronometry by E. Bunning, Springer Verlag.
67. Theory and Practice of Histological Techniques by J. D. Bancroft & A Stevens, Churchill Living stone.
68. Practical Biochemistry in Medicine by Srinivas Rao, Academic Publishers.
69. The Physiology of Reproduction, Vots, I & II, by E. Knobil and J.D. Neil, Raven Press.
70. Introduction to Biotechnology by W.J. Thieman and M.A. Palladino, Pearson Education.
71. Microbiology by G. J Tortora, B. R. Funke, C. I. Case, Pearson Education.
72. A Text Book of Basic and Applied Microbiology, K.R. Aneja, P. Jain, R. Aneja New Age Inc. Pub.
73. Brock Biology of Microorganism by M. T. Madigan et al., Prentice Hall Inc.
74. Microbiology by J.L. Slonczewski and J.W. Foster, W.W. Norton.
75. Fundamentals of Biochemistry by A.C. Deb, New Central Book Agency.
76. Biotechnology by R.C. Dubey; S. Chand Pub.
77. Essentials of Molecular Biology by V. Malathi, Pearson Education.
78. Biostatistics by P. Mariappan, Pearson Education.
79. Genetics and Genomics by Waseem Ahmad (Faridi), Pearson Education.
80. Text Book of Preventive and Social Medicine, M. C. Gupta and B. K. Mahajan, Jaypee Brothers.
81. Microbial Physiology, A G. Moat, J. W. Foster, M. P. Spector, John Wiley Pub.
82. Essentials of Medical Pharmacology by K. D. Trip:lthi, Jaypee Brothers.
83. Environmental Pollution by S. S. Purohit and A. K. AgrawaL Agrobios India.

84. Genera and Applied Toxicology, B. BallanTye, T. Marrs, P. Turner, Macmillan Pub.
85. Environmental Toxicants Edited by M Lippmann, John Wiley Pub.
86. Basic and Clinical Endocrinology Edited by F. S. Greenspan and D. G. Gardner, Lange Medical Book.
87. A Text Book Biophysics by R. N. Roy, New Central Book Agency.
88. Handbook of Biomedical Instrumentation by R. S. Khandpur, Tata McGraw-Hill Pub.
89. Cell Biology by C. B. Power, Himalaya Publishing House.
90. Neuroscience, M. F. Bear, B. w. Connors, M. A Paradiso, Lippincott Williams & Wilkins.
91. Genetics by L. H. Hartwell et al., McGraw-Hill Pub.
92. Cell and Molecular Biology by G. Karp, John Wiley Pub.
93. Fundamentals of Biostatistics by V. B. Rastogi, Ane Books.
94. Exercise Physiology by S. K.. Powers, E. T. Howley, McGraw-Hill Pub.
95. The Physiological Basis of Physical Education and Athletics by E.L Fox and D.K. Mathews. Saunders College Publishing.
96. Statistics in Biology and Psychology by D. Das, Academic Publishers.
97. Pesticides by P.K.. Gupta, Interpret.
98. Environmental Chemistry by A.K. De, New Age Inc.
99. Exercise Physiology - Energy, Nutrition and Human Performance by W.D. McArdle. F. Katch and Y.L. Katch. Williams and Wilkins.
100. Essentials of Exercise Physiology by L.G. Shaver, Surjeet Publications.
101. Text Book of Environmental Physiology by C. Edger Folic Jr., Lea and Febiger.
102. The Pharmacological Basis of Therapeutics by LS. Goodman and A. Gihnan. Macmillan Publishing Co.
103. Quintessence of Medical Pharmacology. S.K. Chaudhuri. New Central Book Agency.
104. Pharmacology in Medicine by S.N. Praclhan. R.P. Maickel and S.N. Dutta. S.P. Press International Inc.
105. Microbiology by M.I. Pelczer & Others; Tata McGraw Hill Publishing Co. Ltd.
106. Biomedical Instrumentation & Measurements, by L. Cromwell, Fj. Weibell & E.A. Pfeiffer; Prentice Hall of India Pvt. Ltd.
107. Molecular Biology and Biotechnology by R.A. Meyers, VCH publishers
108. Recombinant DNA and Biotechnology by H. Kreuzer and A. Massey, ASM press.

109. Park's Text Book of Preventive and Social Medicine by K. Park, Banarsidas Bhanot Publishers.
110. Text Book of Work Physiology by P.O. Astrand and K. Rodahl. McGraw-Hill Book Co.
111. Human Factors in Engineering and Design by E.O. McConnick and M. Saunders. Tata McGraw-Hill.
112. Energy Work and Leisure by J.Y.G.A. Durinand, R. Passmore. Heinemann Educational Books.
113. Sports Physiology by E.L. Fox. Saunders College Publishing. Holt-Saunders.
114. The Principles and Practice on-Tuman Physiology by O. G. Edholm and others Academic Press.
115. Pharmacology by M. Das, Books and Allied (P) Ltd:
116. Basic and Clinical Pharmacology by E.G. Katzung, Appleton and Lange Pub.
117. An Introduction to Biological Rhythms by John D. Palmer, Academic Press.
118. Medical Statistics by B.K. Mahajan. Jaypee Brothers, Medical Publishers Pvt. Ltd.
119. Statistical Methods by G. W. Snedeeor and W.G. Cochnin, Oxford & ffiH Publishing Co Pvt. Ltd.
120. A text Book of Practical Physiology, C. L. Ghai, Jaypee Brothers.
121. Modern Human Physiology, B. K. Chakraborty, H. N. Ghosh, and S. N. Sahana, The New Book Stall.
122. Medical Physiology. A. K. Das, Books and Allied (P) Ltd.
123. The elements of Immunology, F. H. Khan, Pearson Education.
124. The world of The Cell, Becker, Pearson Education.
125. Physiology of Sports and Exercise, 1.H. Wilmore, D. L. Costill, W. L. Kenney, Pub. Human Kinetics.
126. Crash Course of Physiology, Shahid and Nunhuck, Mosby Pub.
127. Introduction to Clinical Nutrition by V. Sardesai, CRC Press.
128. Endocrinology by Hadley, Pearson Education.
129. Introduction to Biochemistry and Metabolism by Anandhi, Pearson Education.
130. Modern Experimental Biochemistry by Boyer, Pearson Education.
131. Cell Organization and Function by Shakir Ali, Pearson Education.
132. Fundamentals of Immunology by Sumitha Pearson Education.
133. IPR, Biosafety and Bioethics, Goel and Parashar, Pearson Education.
134. Practical Physiological Chemistry by P.B. Hawk, B.L. Oser, W.H. Summerson, McGraw-Hill Publishing Co.

135. Basic Concept in Immunology, A. Hati, S. Roy, B. Saha, K. Bharati, Allied Book Agency, Kolkata.
136. Nutritive Value of Indian Foods, by C. Gopalan and other, NIN, Hydreabad.
137. Text book of Microbiology, by R. Anantanarayan and C. K. Joyram Paniker, Oriennt Longman.
138. Food Microbiology by W.C Frazier and D.C. Westhoff. Tata McGraw Hill Publisher.
139. Text book of Preventive and Social Medicine by M.C. Gupta and B.K. Mahajan, Jaypee Bothers.
140. Recombinant DNA by J.D. Watson, M. Gilman, J. Witkowski and M. Zoller, Scientific American Books.
141. Biotechnology by S. S. Purohit; Agrobios , India.
142. Lippincott's Illustrated Review of Physiology, by R. R. Preston; Lippincott Williams and Wilkins.
143. Computer in Biology by Prof P.C. Dhara. Academic Publication, Kolkata.
144. Vander's Human Physiology by E.P. Widmaier et al., McGraw Hill Publication.

PHYSIOLOGY
(GENERAL COURSE)

PART-I
(One year course)

PAPER-I (Theory): 100 Marks

Unit-01: 50 Marks

		Lectures
i)	Physiology as a science of excellence	01
ii)	Units of human system	06
iii)	Biophysical & Biochemical principles involved in human system	08
iv)	Conservation of matter and energy in human system	
	a) Alimentation	10
	b) Biochemistry & Metabolism	20
	c) Nutrition & Dietetics	10

Unit-02: 50 Marks

i)	Blood & Body Fluids	10
ii)	Cardiovascular System	25
iii)	Respiratory System	12
iv)	Renal Physiology	08

PART-II
(One year course)

Paper-II (Theory): 100 Marks Lectures

Unit-03: 50 Marks

i)	Nerve-Muscle Physiology	17
ii)	Nervous System	
iii)	Skin and Regulation of Body Temperature	

Unit-04: 50 Marks

i)	Sensory Physiology	17
ii)	Endocrine System	28
iii)	Reproductive Physiology	10

Paper- III (Practical): 100 Marks Distribution of Marks

A. Histology	30
B. Biochemistry	20
C. Experimental Physiology	05
D. Human Experiments	15
E. Diet Survey Report	10
F. Excursion	05
G. Laboratory Note Books	10
H. Viva-Voce	10

PART-III

Paper-IV A (Theory): 70 Marks Lectures

1.	Application of Physiology	02
2.	Clinical Biochemistry and Molecular Biology	15
3.	Environmental Physiology	08
4.	Microbiology and Immunology	15
5.	Work and Sports Physiology	10
6.	Biostatistics and Modern Instrumentation (Biomedical) & Basic Concepts of Computer	10
7.	Community Health Management	10

Paper-IVB (Practical): 30 Marks Distribution of Marks

A. Hematological Tests	05
B. Clinical Pathology	10
C. Human Experiments	08
D. Laboratory Note Books	03
E. Viva-Voce	04

PHYSIOLOGY
(General Course)

PART-I
(One year course)

PAPER-I
(University Written Examination - 90 marks, Internal Assessment in College - 10 marks)

Unit-01: 50 Marks

1. Physiology as a science of excellence:

Role of Physiology as a basic science. Scope of physiology in improvement of health, nutrition, family planning, physical performance and in various fields. Role of Physiology in interaction of human and environment. **(1 lecture)**

2. Units of human system:

Structure-function relationship of a cell & different tissues. Cell membrane, cell organelles - structure & function. **(6 lectures)**

3. Biophysical & Biochemical principles involved in human system:

Physical importance of the following processes: diffusion, osmosis, dialysis, ultra-filtration, surface tension, absorption, adsorption. Brief ideas of acid, base, buffer, indicator. pH: definition, significance & maintenance of pH in the body. Colloids: definition, classification, property and physiological importance. Enzyme: definition, classification, factors affecting enzyme action. Mode of enzyme action. Concept of co-enzyme, iso-enzyme, anti-enzyme, Catalyst (in brief). **(8 lectures)**

4. Conservation of matter and energy in human system:

a) Alimentation:

Structure in relation to function of alimentary canal and digestive glands. Composition; function and regulation of secretion of digestive juice including bile. Digestion and absorption of food stuffs. Movements of the stomach & small intestine. **(10 lectures)**

b) Biochemistry & Metabolism:

Chemistry of carbohydrates, lipids, proteins and nucleic acids. Glycolysis, Hexose monophosphate shunt, glycogenesis, glycogenolysis, TCA cycle, gluconeogenesis. Depot fat, fatty acid oxidation, ketone bodies: synthesis & their significance. Deamination, transamination. **(20 lectures)**

Amino acid pool-Fate & functions of amino acids in the body. Formation of urea & its importance. Elementary idea of electron transport chain, oxidative-phosphorylation.

c) Nutrition & Dietetics:

Basic constitution of food & their nutritional significance. Vitamins: definition, classification, function, deficiency symptoms & daily requirements, hyper-vitaminosis. Mineral metabolism: Ca, Fe, P. BMR: definition, factors affecting, determination by Benedict Roth apparatus. RQ: definition, factors affecting, significance. Biological value of proteins, essential & non essential amino acids, N_2 equilibrium, minimum protein requirement. Positive and negative N_2 balance. SDA - definition & importance. **(10 lectures)**

Unit-02: 50 Marks

1. Blood & Body Fluids

Blood - composition, functions. Plasma Proteins: origin, functions, separation. Plasma-pheresis: bone marrow, formed elements of blood - their formation, functions, fate. Hemoglobin: types of compounds & derivatives. Hematocrit value and its

importance. Blood volume determination (dye & radio isotope methods), regulation. Blood coagulation: mechanism, factors affecting, anticoagulation. Disorders of blood coagulation. Lymph & tissue fluid: composition, formation & functions. Blood groups. Blood transfusion & incompatible transfusion. **(10 lectures)**

2. Cardio- Vascular System

a) Heart: Anatomy & histology of heart, properties of cardiac muscle, origin & propagation of cardiac impulse, Events of cardiac cycle, Heart rate, Heart Sound, Heart rate control, Cardiac output: Methods (dye & Fick methods), factors affecting, regulation. ECG - normal waves, different intervals. Myocardial Infarction. Atherosclerosis, thrombosis, hypertension, heart block, cardiac myopathy - a brief idea.

b) Circulation: Structure of arteries, arterioles, capillaries, venules and veins. Pulse - arterial & venous. Blood pressure and its regulation, measurement of blood pressure. Peculiarities of regional circulations: coronary, pulmonary, renal, hepatic, cerebral. **(25 lectures)**

3. Respiratory System

Anatomy & histology of the respiratory passages and organs. Role of respiratory muscles in respiration. Artificial respiration, significance of anatomical and physiological dead space, lung volumes and capacities. Exchange of respiratory gases between lung and vessels, and between tissues. Transport of O_2 and CO_2 in vessels. Regulation of respiration - neural & chemical. Hypoxia, apnea, hypercapnia, orthopnea, cyanosis. Mountain sickness, acclimatization. **(12 lectures)**

4. Renal Physiology

Relationship between structure & function of kidney. Mechanism of the formation of urine. Physiology of urine storage, micturition. Renal regulation of acid-base balance. Normal & abnormal constituents of urine. Non excretory functions of kidney. Renal function tests. **(8 lectures)**

Framing of questions and distribution of marks in each unit of theoretical question papers:

1. Five short answer type questions are to be answered from eight questions of two marks each. (10 marks).
2. Four semi-long answer type questions are to be answered from six questions of 5 marks each (20 marks).
3. One long answer type question is to be answered from two questions of 15 marks each which will be subdivided into two components: 8 marks and 7 marks.

PART-II
(1 year course)

PAPER-II
(University Written Examination - 90 marks, Internal Assessment in College - 10 marks)

Unit-03: 50 Marks

1. Nerve-Muscle Physiology:

Different types of muscles & their structures. Concept of sarcotubular system. Red and white muscles. Mechanism of muscle contraction. Structural, chemical and mechanical changes in skeletal muscle during contraction & relaxation. Isotonic and isometric contraction. Properties of muscle: all or none law, beneficial effect, summation, refractory period, tetanus and fatigue. Single-unit and multi-unit smooth muscle. A brief idea of muscle spindle.

Structure & classification of nerves. Origin & propagation of nerve impulse. Velocity of impulse in different types of nerve fibres. Properties of nerve fibre: all or none law, rheobase, chronaxie, refractory period, indefatiguability. Synapse: structure, classification, mechanism of synaptic transmission. Motor unit, motor point. Neuromuscular junction: structure, mechanism of impulse transmission, end plate potential. A brief overview on neurotransmitter. Degeneration & regeneration of nerve fibre. Myelination. **(17-lectures)**

2. Nervous System:

A brief outline of the organization and functions of nervous system (sensory, motor, association). CNS and PNS (emphasis on the structure of spinal cord and brain stem). Ascending and descending tracts: pyramidal tract and extra pyramidal tracts (in brief). Reflex action: definition, reflex arc, classification, properties. Functions of spinal cord. Outline of functions of brain stem. A brief idea about the structure, connection and function of cerebral cortex: histological structure and localization and function. Basic concept of upper and lower motor neurons. A brief description of the organization of autonomic nervous system (sympathetic and parasympathetic). Functions of ANS. CSF: formation, circulation and functions. **(30 lectures)**

3. Skin & Body Temperature Regulation:

Structure and functions of skin. Sensible and insensible perspiration. Composition and functions of sweat and sebum. Physiology of sweat secretion and regulation. Regulation of body temperature - physical, physiological processes involved in it. Significance of body temperature. Types of Heat stress, Heat stroke and Management.

(8 lectures)

Unit-04: 50 Marks

1. Sensory Physiology:

Classification of general and special senses, and their receptors. Receptors as biological transducers. Muller's law of specific nerve energies. Weber-Fechner law. Concept of receptor adaptation.

a) Olfaction & Gustation: Structure of sensory organs, neural pathway of smell & taste sensation. Chemistry of taste & smell. Mechanism of taste sensation. Olfactory and gustatory adaptation. After taste.

b) Audition: Structure of ear, auditory pathway, organ of Corti, mechanism of hearing, perception of pitch and loudness.

c) Vision: Structure of the eye. Histology of retina, visual pathway, light reflex, chemical changes of retina on exposure to light. Accommodation: mechanism & pathway. Error of refraction & correction. Positive & negative after-image, optical illusion, flicker, light & dark adaptation. Elementary idea of colour vision & colour blindness. **(17 lectures)**

2. Endocrine System:

Anatomy of endocrine system. Classification of hormones. Basic concept of the regulation of hormone actions. Positive and negative feedback mechanisms. Elementary idea of hormone action.

Pituitary: Histological structure, hormones and their functions, hypothalamo-pituitary axis. Hypo and hyper active states of pituitary gland. Neuro-hormones: Vasopressin and oxytocin.

Thyroid: Histological structure, functions of T3, T4, thyrocalcitonin. Hypo- and hyperactive state of thyroid. Goitrogens.

Parathyroid: Histological structure, functions of parathyroid hormone. Parathyroid tetany; Hyperparathyroidism.

Adrenal: Histological structure and functions of medullary hormones. Adrenal cortex: Histological structure and functions of cortical hormones. Hypo and hyperactive states of adrenal cortex.

Pancreas: Histology of islets of Langerhans. Origin and functions of pancreatic hormones. Hormonal regulation of blood glucose/sugar level. Diabetes mellitus.

Local hormones: (Brief idea) - The origin & functions of renin angiotensin system. Prostaglandins. Erythropoietin and melatonin. Elementary idea about gastrointestinal hormones. **(28 lectures)**

3. Reproductive Physiology:

Primary and accessory sex organs, Secondary sex characters. Puberty- A brief idea. Testis: histology, spermatogenesis, Testicular hormones and their functions. Ovary: Histology, oogenesis, ovarian hormones and their functions. Estrous and menstrual cycle, and their hormonal control. Fertilization, implantation. Placenta formation and its function. Placental hormones, maintenance of pregnancy, hormonal factors, parturition. Pregnancy tests. Development of mammary gland and lactation.

(10 lectures)

PRACTICAL
PAPER-III

A. Histology: 30 Marks

i) Hematological Experiments: **(10 marks)**

a) Leishman's staining of human blood film & identification of different blood corpuscles.

b) Preparation of haemin crystals.

c) Estimation of hemoglobin

ii) Fresh tissue experiments: **(10 marks)**

a) Examination & staining of fresh tissue: squamous, ciliated & columnar epithelium, skeletal muscle fibre (Rat/Goat) by Methylene blue stain.

b) Transitional epithelium, mesentery (Rat/Goat) (counter stain by Methylene blue).

c) Staining of adipose tissue by Sudan III or IV.

iii) Identification of permanent slides: **(10 marks)**

Bone, cartilage, lung, trachea, spleen, lymph gland, liver, salivary glands, pancreas, esophagus, stomach, small intestine, large intestine, ovary, adrenal, testis, thyroid, spinal cord, cerebellum, cerebral cortex, kidney, skin, tongue.

iv) Demonstration: Eosin - Haematoxylene staining of blood film, Reticulocyte staining.

B. Biochemistry: 20 Marks

i) <u>Qualitative Experiments</u> **(10 marks)**

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

b) Qualitative analysis of pulse, rice, milk to test the presence of carbohydrate, protein, fat. Demonstration of qualitative identification of lipid & cholesterol.

ii) Quantitative Analysis **(10 marks)**

a) Quantitative estimation of glucose, sucrose by Benedict's method.
b) Estimation of lactose from milk by Benedict's method
c) Estimation of blood sugar by Folin-Wu method.
d) Estimation of chloride by Mohr's Method.
e) Estimation amino-nitrogen through formol-tritration method.

C. Experimental Physiology: 5 Marks (5 marks)

Demonstration: Students will be trained to interpret the prepared supplied curve.

a) Use of Kymograph, induction coil and keys.
b) Recording of simple muscle curve with sciatic nerve-gastrocnemius muscle preparation of a toad. Determination of latent period, contraction period, relaxation period & maximum height of contraction.
c) Normal tracing of unperfused toad's heart beat.
d) Effect of warm saline on unperfused toad's heart beat.
e) Effect of ion (K^+ & Ca^{2+}) on unperfused toad's heart beat.
f) Effect of adrenaline and acetylcholine on unperfused toad's heart beat.

D. Human Experiments: 15 Marks

a) Determination of PFI of an individual by Harvard Step Test and graphical plotting of changes in pulse & breathing rate during recovery period.
b) Measurement of systolic and diastolic arterial blood pressure by sphygmomanometer and determination of pulse pressure & mean pressure during quiet rest and exercise.

E. Diet Survey Report: 10 Marks

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

F. Laboratory Note Books: 10 Marks

LNB for Biochemistry - 4 marks
LNB for Histology - 3 marks

LNB for Experimental Physiology-3 marks

G. Viva-Voce: 10 Marks

PART-III
(1 year course)

PAPER-IV A
(University Written Examination - 63 marks, Internal Assessment in College - 07 marks)

1. **Application of Physiology:**
Introduction to the application of Physiology in different fields – Hematology, Biochemistry, Molecular Biology, Immunology, Microbiology, Social Physiology, Work and Sports Physiology, Environmental Physiology, Space Physiology, Pharmacology. **(2 lectures)**

2. **Clinical Biochemistry and Molecular Biology:**
DNA and RNA: types and functions. Elementary idea of gene, genome, genetic code, transcription, translation and genetic engineering. Pathological significance of the following blood constituents: glucose, urea, creatinine, uric acid, cholesterol, lipoproteins, bilirubin, SGPT and SGOT, alkaline and acid phosphatases and ketone bodies.

   Dose response relationship. ED 50, LD 50, CO, TLV, therapeutic index of drugs, safety factor for drugs and pollutants. Narcotic drug abuse and addiction, addiction of alcohol and nicotine. Abuse of medicines: sulfa drugs, antibiotics, androgenic steroids, doping. **(15 lectures)**

3. **Environmental Physiology:**
Environment - its physiological aspect. Some common pollutants & their effect- Carbon monoxide, lead & arsenic. Effects of noise on human body and preventive measures. Pesticides: Bio magnification and effects on body. Radio-active wastes and their health effects. Natures Kidney as scavenger. Food pollution and adulteration & their effects on human body. **(8 lectures)**

4. **Microbiology & Immunology:**
Virus: DNA virus & RNA virus, phages. Bacteria - structure & morphological classification. Gram positive, gram negative, pathogenic & nonpathogenic bacteria. Sterilization, pasteurization, brief idea about antibiotics, idea about innate and acquired immunity. Humoral and cell mediated immunity. Vaccination principles and importance of immunization. Basic principles of immunological detection of pregnancy.
Immunization Program: Immunization against Polio, Hepatitis-B, Tetanus, Measles, Whooping cough, Tuberculosis, Rabbies through vaccine, AIDS- causative virus, mode of transmission, effects on human body, preventive measures, diagnostic test for AIDS (ELISA). **(15 lectures)**

5. **Work & Sports Physiology:**
Definition of work, cardiac index, work index or pulse, O_2 debt, classification of physical work - static & dynamic, positive & negative work, cardiovascular & respiratory changes during physical exercise. Brief idea about VO_2 max, physical fitness index - Harvard step test. **(10 lectures)**

6. **Biostatistics and Modern Instrumentation (Biomedical) & Basic Concepts of Computer:**
Sampling and its methods, frequency distribution, properties & computation of standard deviation. Sampling errors, standard error or difference between means. Principle & application of artificial pacemaker, MRI, hemo-dialysis, USG, CT scan, X-ray, endoscopy. Basic concept of computer, uses of computer, elementary ideas about hardware, software and software packages. **(10 lectures)**

7. **Community Health Management:**
Basic Concept of Population, Society, Community and Community Health. Population control & family planning, causes and management of different types of diabetes, thalassemia, nutritional anemia, atherosclerotic disorders, gout, obesity, filria, endemic goiter. Dental carries. **(10 lectures)**

PRACTICAL

PAPER-IVB

A. Hematological Tests: 5 Marks

a) DC of WBC, PCV, MCV, determination of clotting time, bleeding time, ABO grouping.
b) Demonstration - TC of RBC & WBC. Haematocrit, ESR.

B. Clinical Pathology: 10 Marks

a) Identification of abnormal constituents of urine - glucose, proteins, acetone, blood, bile salts.
b) Pregnancy Test (strip method).

C. Human Experiments: 8 Marks

a) Pneumographic recording of normal respiratory movements, recording during drinking water, talking, forced hyperventilation & breath holding.
b) Spirometric measurement of vital capacity.
c) Determination of VO_2 max by Queen's College method.
d) Measurements of cornmon anthropometric parameters: stature, eye height, shoulder height, elbow height, knee height (sitting). Circumference: head, chest, wrist, hip. BMI measurement.
e) Calculation of body surface area.

D. Laboratory Note Books: 3 Marks

E. Viva-Voce: 4 Marks

RECOMMENDED TEXT AND REFERENCE BOOKS FOR PHYSIOLOGY (GENERAL), PART-I, II AND III

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

1. Human Physiology Vol. 1 & 2, C.C. Chatterjee, Medical Allied Agency.
2. Sharirbigyan (Bengali) Vol. 1, 2 & 3. Debnath, Sridhar Prakashani.
3. Modem Human Physiology, B.K. Chakraborty, H.N. Ghosh, and S.N. Sahana, The New Book Stall.
4. Concise Medical Physiology, S. K. Chowdhury, New Central Book Agency.
5. Biochemistry, D. Das, Academic Publishers.
6. Paripak Bipak o Pusti. D. Das, Paschim Banga Rajya Pustak Parshad.
7. Bailey's Text Book of Histology, M.S.H. Di Fiore, Lea and Febiger.
8. Atlas of Human Histology, M.S.H. Di Fiore, Lea & Febiger. The New Book Stall.
9. Essential of Exercise Physiology, L.G. Shaver, Surjeet Publications.
10. Text book of Medical Physiology, by A.C. Guyton, John E. Hall, Eleventh edition. Elsevier Saunders.
11. The Living Body, O.H. Best & N.B. Taylor, Williams and Wilkins.
12. Human Physiology Vol. 1 & 2, T.K. Basu, Biomed Publications.
13. Biomedical Instruments and Measurements, L. Cromwell, F.1. Weibell, E.A. Pafaiffer Prentice Hall of India Pvt. Ltd.
14. A text Book of Practical Physiology, C.L. Ghai, Jaypee Brothers Medical Publishers Pvt. Ltd.
15. Medical Physiology, A. K. Das, Books and Allied (P) Ltd.
16. Medical Physiology, A.B. Singha Mahapatra, Current Books International.
17. Essentials of Medical Physiology, K. Sembulingam and P. Sembulingam, Jaypee Brothers Medical Publishers Pvt. Ltd.
18. Note Books on Practical Biochemistry, Experimental Physiology J and Histology (Published by the Physiological Society of India, Kolkata).
19. Text book of Medical Physiology by Veena M. Ahuja, Ane Books.
20. Environmental Chemistry by A K. De, New Age Inc.
21. Text book of Microbiology, by R. Anantanarayan and C. K. Joyram Paniker, Oriennt Longman.
22. Immunology, by D.M. Weir, ELBS.
23. Park's Text Book of Preventive and Social Medicine, by K. Park, Banarsi Bhanot Publishers.

24. Nutritive Value of Indian Foods, by C. Gopalan and other, NIN, Hyderabad.
25. Physiology by A.B. Singha Mahapatra, Current Books International.
26. Harpers's Biochemistry, by R. K. Murry and Others, Lange Medical Book, Prentice-Hall International.
27. Hawk's Physiological Chemistry by B.L. Oser, Tata McGraw-Hill Publishing Co. Food and Nutrition by M. Swaminathan, The Bangalore Printing & Publishing Co. Ltd.
28. Essential Food and Nutrition by M. Swaminathan. The Bangalore Printing & Publishing Co. Ltd.
29. Statistics in Biology and Psychology by D. Das and A. Das, Academic Publishers.
30. Basic Concept in Immunology, A. Hati, S. Roy, B. Saha, K. Bharati, Allied Book Agency, Kolkata.