MODIFIED SYLLABUS-04.06.2019-FULL AND FINAL

Kazi Nazrul University, Asansol

B.Sc. in Physiology [Choice Based Credit System]

Honours

SYLLABUS

Department of Physiology, Kazi Nazrul University, Asansol Summary of the Curriculum For B.Sc. with Physiology[Choice Based Credit System] General

B. Sc. Physiology
Honours Course
Semester I

Core Course I: Cell Biology and Biophysics (6 Credits)

1. Cell Biology and Genetics:

Electron microscopic structure and functions of eukaryotic nucleus, endoplasmic reticulum, ribosome, Golgi bodies, mitochondria, lysosomes, peroxisomes ,cytoskeletal elements, centrosomes and plasma membrane . Ion pores, ion pumps, ion channels, ionophores, passive transport – facilitated diffusion, uniport, symport, antiport. Active transport, Artificial membrane –liposome and erythrocyte ghost. Basic idea of tight junctions, gap junctions and cell adhesion molecules Chromosome structure – morphology. Chromosomal DNA packaging – nucleosomes and higher levels of organization of chromatin. Euchromatin and heterochromatin. Human genome and its characteristics. Nuclear and mitochondrial DNA. Cell cycle – events and regulatory role of cyclin. Elementary idea of apoptosis

[2 Credits] (24 lectures)

2. Biophysical principles:

Diffusion, surface tension and viscosity -- characteristics, factors influencing and biological applications. Osmosis: osmotic pressure – laws, determination – freezing point depression method and biological applications. Protolysis of water,pH, acid-base neutralization curves, Buffer action: Henderson Hasselbalch equation. Regulation of pH by blood buffers. Determination of pH –indicators, principle of pH meter- hydrogen electrode and glass electrode. Colloids : Classification, properties – optical, electrical, electrokinetic. Biological importance of colloids. Dialysis and ultrafiltration. Gibbs-Donnan membrane equilibrium , Nernst equation. Thermodynamics : Type of surroundings and systems. First Law– internal energy, enthalpy. Second Law – Entropy, Free energy change, Endergonic and Exergonic reactions, Reversible and Irreversible processes, Equilibrium constant. Physiological steady-state, Living body as a thermodynamic system.

[2 Credits] (24 lectures)

3. **Enzymes:**

Classification- EC nomenclature, apoenzyme, holoenzyme, coenzyme, cofactors and prosthetic group. Mechanism of enzyme action : Activation energy, Enzyme-substrate complex, Transition state and Products. Models of enzyme-substrate interactions. Specificity of enzymes. Concept of initial rate, maximum velocity and steady-state kinetics. Michaelis constant, Michaelis-Menten equation, Graphical representation of hyperbolic kinetics-- Lineweaver-Burk plot. Significance of K_m and V_{max}. Factors influencing enzyme-catalyzed reactions : substrate concentration, enzyme concentration, pH, temperature. Competitive, non- competitive and uncompetitive inhibitions. Regulation of enzyme activities -- covalent modifications, allosteric modifications – Sigmoid kinetics and Hill equation : K- and M- series, Feedback inhibition. Rate-limiting enzymes. Isozymes, Ribozymes and Abzymes**[2 Credits] (24 lectures)**

Core Course II: Biochemistry (Theory) (4 Credits)

1. Biochemistry of Carbohydrates and lipids :

Monosaccharides – classification, structure, stereoisomerism, epimerism. Cyclic structures- pyranose and furanose forms, anomerism, optical activity, 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, deoxysugars, sugar alcohols, sugar acids, sugar esters, their biochemical and physiological importance. *Disaccharides* –Maltose, Lactose and Sucrose : Structure, Occurrence and Physiological importance. *Polysaccharides* – structure occurrence, and physiological importance of Starch, Glycogen, Dextrin, Cellulose, Glycosaminoglycans, Glycoproteins, Sialicacids, Lectins, Blood group polysaccharides. Lipids **:** classification. Fatty acids - classification, systemic nomenclature andstructure. 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 and its ester - their structure and physiological importance. Lipoproteins - Structure and classification.
[2 Credits] (24 lectures)

2. Biochemistry of Amino acids, proteins and nucleic acids: Classification, Structure, Nomenclature and Optical properties. Protonic equilibria ofamino acids – Zwitterions, Isoelectric point, titration curve of amino acids. Reactions with ninhydrin and formaldehyde. Peptides and Proteins **:** Structure and properties of peptide bonds--Phi and Psi angles. Reactionswith 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. Denaturation and Renaturation. 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 Cot value.
[2 Credits] (24 lectures)

Core Course II: Practical (2 Credits)

Qualitative Biochemistry

a. Qualitative analysis of biochemical molecules: Carbohydrates- Glucose, fructose, maltose/ lactose, sucrose, starch, dextrin. Protein -Albumin, gelatin, peptone; Others - glycerol, bile salts , acetone, HCI, lactic acid, urea

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

Interdisciplinary/ Generic Elective (G.E.) for Other Departments
Semester - I

GE I : Blood and Immunology [4Credits]

Blood and Immune system in health and diseases

Blood – Composition and functions, blood cell formation and related disorders, Blood groups , Blood transfusion and its hazards, Blood clotting and its disorders, Normal and abnormal haemoglobins. Immunity- innate and acquired, Antigens , antibody –structure, classification and functions , Cytokines, phagocytosis, , Cytotoxicity, Allergy, Inflammation , Autoimmune diseases – Arthritis , Graves disease, Myasthenia Graves, Hashimoto's disease. Vaccines, toxoids, HIV

GE I Lab : Practical (2 Credits)

1. Fresh tissue experiments:

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

2. Identification of permanent slides:

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.

SEMESTER-II

Core Course III: Blood and Cardiovascular System [4 Credits]

1. Blood :

Formed elements of blood–origin, formation, functions and fate. Plasma proteins–origin and functions. Haemoglobin – Structure, compounds and derivatives, biosynthesis and catabolism. Foetal hemoglobin. Haemoglobinopathies- Thalassemia ,Sickle-cell anemia. Anemia-different types and their causes. Blood volume – regulation and determination by dye and radioisotope methods. Hemostasis – factors, mechanism, anticloting mechanism, anticoagulants, procoagulants. Disorders of hemostasis-Hemophilia, Thrombosis and Embolism. Blood types – ABO and Rh systems, H- antigen. Erythroblastosis foetalis and Rh antigens. Bombay type blood group, Blood transfusion and its hazards. Red cell fragility **[1.5 Credits] (18 Lectures)**

2. a) Cardiovascular System – I :

Histology of Heart- Nodal tissues, ventricles and valves. Properties of cardiac muscle. Origin and propagation of cardiac impulse-action potential in nodal and ventricular muscles. The cardiac cycle-events, pressure and volume changes. Heart sounds. Murmurs. Cardiac output – measurement by application of Fick's principle and dye dilution method, factors affecting. Starling's law of heart. Electrocardiography – the normal electrocardiogram, electrocardiographic leads, vectorial analysis, the vectorcardiogram, the mean electrical axis of heart. The His bundle electrogram. Principles of Echocardiography. Cardiac Arrhythmias. Myocardial Infarction.**)**

b) Cardiovascular System – II :

Functional morphology of arteries, arterioles, capillaries, venules and veins, sinusoids. General pattern of circulation and significance of branching of blood vessels. The pulse – arterial and venous. Hemodynamics of blood flow. Blood pressure – its measurement and factors affecting. Cardiovascular homeostasis – neural and chemical control of cardiac functions and blood vessels. Cardiac and vasomotor centers, baroreceptors and chemoreceptors, innervation of the heartand blood vessels, cardiac and vasomotor reflexes. Cardiovascular adjustment after haemorrhage. **[2.5 Credits](30 Lectures)**

Core Course-III : Practical [2 Credits]

Hematology

Hematological experiments : Preparation and staining of blood film with Leishman's stain. Identification of blood corpuscles.Differential count of WBC. Total count of RBC and WBC. Haemoglobin estimation. Preparation of haemin crystals. Preparation and staining of bone marrow smear. Measurement of diameter of megakaryocyte. Reticulocyte staining. Blood group determination. Demonstration: Haematocrit, MCV, MCH and MCHC. Bleeding time, Clotting time, ESR.

Core Course IV: Respiratory and Circulation [4 Credits]

Respiration

Anatomy and histology of the lung and airways. Mechanics of breathing -- role of respiratory muscles, glottis. Lung volumes and capacities. Compliance of lungs and chest wall, pressure-volume relationship, alveolar surface tension and surfactant, work of breathing. Ventilation- perfusion ratio. Dead space and uneven ventilation. Spirometry. Transport of gases in body - Partial pressure and composition of normal atmospheric gases in inspired, expired, alveolar air and blood. Oxygen dissociation curve of hemoglobin and myoglobin – factors affecting. Carbon dioxide dissociation curve. Regulation of respiration -- neural and chemical, respiratory centers, chemoreceptors, baroreceptors, pulmonary receptors. Hypoxia – types, effects. Asphyxia, Voluntary hyperpnoea, Apnoea, Cyanosis, Periodic breathing, Asthma, Emphysema. Lung function tests. Artificial respiration. Concept of non-respiratory functions of lung.

[2.5 Credit]((30 Lectures)

Body Fluids and Regional Circulation :

Lymph and tissue fluids – formation, circulation, functions and fate. Lymphatic organs-Histological structures and functions of lymph gland and spleen. Regional circulations – cerebral, coronary, pulmonary and hepatic, skeletal muscle

[1.5 Credit] (18 Lectures)

Core Course-IV: Practical [2 Credits]

Histology – fresh tissue preparation

Suitable staining and examination of fresh tissues – epithelial, areolar, adipose(Sudan III or IV) and muscle tissues. Silver
nitrate preparation of cornea and urinary bladder for cell spaces and sciatic nerve for nodes of Ranvier

Semester - II

GE II : Gastrointestinal Physiology (4 credit)

Community health and Nutrition

Definition & concept of health and diseases, dimension of health, health system, Diseases: causation and prevention of diseases, mode of intervention, epidemic and endemic forms of diseases, physiologists as health counsellors

Nutrition in infancy: Nutritional requirements of nutrients during infancy. Breast feeding – nutritional and others factors, advantages, problems in breast feeding, Infant milk substitute (IMn S) act 1992. Formula feeding, Vitamin and mineral supplementation – vit –D, Iron, Fluoride, Supplementary foods of milk, cow's milk, goat's milk, vegetarian beverages, fruit juice. Nursing caves; solid supplements wearing, Nutritional requirement of pre- term babies; Feeding problems – food allergies, cow's milk protein allergy, lactose intolerance, diarrhoea, constipations vegetarianism

Nutrition in childhood and adolescence: Nutritional requirement of pre-school and school children, monitoring growth and development. Nutrition related problems of children- childhood obesity, dental caries, allergies, deficiency of Vit-A- aetiology, symptoms, prevention. Nutritional requirement and problem of adolescents-Anorexia nervosa, Bubnia nervosa, Binge eating disorder, premenstrual syndrome.

Nutrition in pregnancy: maternal factors effecting pregnancy outcome: maternal age, pre-pregnant weight, weight gain during pregnancy, life style factors. Birth weight standards,Low birth weight baby. Nutritional requirements during pregnancy. Problems in pregnancy- morning sickness, nausea and vomiting, constipation, oedema and leg cramps, Heart burn, excessive weight gain. Complication- anemia, toxemia, Diabetes mellitus

Nutrition in lactating women: Nutritional requirements, Factors affecting the volume and concentration of breast milk

Protein energy malnutrition:- PEM- symptoms, nutritional requirement in dietary management.

Nutritional anemia:-Prevalence, Iron metabolism, Iron absorption enhancers and inhibitors, Clinical features & management of Iron deficiency anemia, Megaloblastic anemia.

Cardiovascular disorders-Coronary heart disease (CHD): food and nutrients in CHD. Cardiovascular risk factors and nutritional management of CHD **Diabetes mellitus**-Dietary management of Diabetes mellitus – nutritional requirements, glycaemia index, Complication of diabetes – hypoglycaemia and insulin shock.

Nutrition and aging: Process of aging, changes in organ function with aging, nutritional requirement, nutrition related problems in old age- osteoporosis, anaemia, obesity, constipation, malnutrition. Antioxidants in the health of old age

Overweight and obesity:- prevalence, factors – environmental and life style factor, food intake, Genetic factors. Obesity management.

GE II (Lab) : Credit(2)

Biochemistry

Qualitative Experiments:
Qualitative tests for identification of starch, dextrin, lactose, sucrose, glucose, fructose, albumin, gelatin, peptone, lactic acid, hydrochloric acid, acetone, glycerol, bile salts, urea.
Quantitative Experiments:
a) Quantitative estimation of glucose by Benedict's method.
b) Quantitative estimation of amino-nitrogen by Sorensen' s formol titration method.
(Percentage and total quantity to be done).

SEMESTER III

Core Course-V : Nerve ,Muscle and Renal Physiology [4 credits]

Muscle Physiology :

Microscopic and electron microscopic structure of skeletal, smooth and cardiac muscles. The sarcotubular system. Red and white striated muscle fibers. Single-unit and multi -unit smooth muscle. Muscle groups : antagonists and agonists. Properties of skeletal muscle: excitability, contractility, all or none law, ummation of stimuli, summation of contractions, effects of repeated stimuli, genesis of tetanus, onset of fatigue, refractory period, tonicity, conductivity, extensibility and elasticity. Optimal load, optimal length of fibers. Muscle proteins. Mechanism of skeletal and smooth muscle contraction and relaxation : Excitationcontraction coupling. Dihydropyridine receptors & Ryanodine receptors. Mechanical components of muscle. Isometric and isotonic contractions – muscle length, tension and velocity relationships. Chemical, thermal and electrical changes in skeletal muscle during contraction and relaxation. Electromyography**[1.5 Credits](18 Lectures)**

Nerve Physiology:

Structure, classification and functions of neurons and neuroglias. Cytoskeletal elements and axoplasmic flow.

Myelinogenesis. The resting membrane potential. The action potential. Electrotonic potentials. Current of injury.

Propagation of nerve impulse in different types of nerve fibers. Compound action potentials. Properties of nerve

fibers : excitability, conductivity, all or none law, accommodation, adaptation, summation, refractory period,

indefatigability. Chronaxie, rheobase and utilization time. Synapses : types, structure, synaptic transmission of the

impulse, synaptic potentials, neurotransmitters, cotransmitters, neuromodulators. The neuromuscular junction :

structure, transmission, end-plate potential, MEPP, post-tetanic potentiation. Motor unit. Motor point. Injury to

peripheral nerves – degeneration and regeneration in nerve fiber, changes in the nerve cell body, transneuronal

degeneration, changes in receptors and motor end-plates, denervation hypersensitivity. Thermal changes of nerve

during activity. Nerve growth factors.**[1.5 Credits](18 Lectures)**

Renal Physiology :

Anatomy of kidney. Histology of nephron. Renal circulation – peculiarities and autoregulation. Formation of urine

– glomerular function and tubular functions. Counter-current multiplier and exchanger. Renal regulation of osmolarity and volume of blood fluids. Diabetes insipidus. Formation of hypertonic urine. Renal regulation of acid

-base balance, acidification of urine. Renal function tests – creatinine, inulin, urea, and PAH clearance tests.

Physiology of urinary bladder and micturition. Composition of urine. Abnormal constituents of urine, their detection and significance. Renal dialysis. Non-excretory functions of kidney**[1 Credit](12 Lectures)**

Core Course-V Practical [2 Credits]

a)Permanent slides

Study and identification of stained section of different mammalian tissues and organs : Bone, Hyaline cartilage,

Trachea, Lung, Spleen, Lymph gland, Parotid gland, Submaxillary gland, Sublingual gland, Tongue, Oesophagus,

Stomach, Duodenum,

Jejunum, Ileum, Large intestine, Liver, Kidney, Ureter, Pancreas, Adrenal gland, Thyroid

gland, Testis, Ovary, Spinal cord, Cerebral cortex, Cerebellum, Skin, Cardiac muscle,

Skeletal muscle, Smooth muscle, Artery, Vein, Uterus**.**

b) Paper chromatography , TLC

Core Course-VI : Digestive System and Molecular Biology[4 Credits]

Digestive system,

Anatomy and histology of alimentary canal. Digestive glands – histological structures of salivary glands, pancreas,
liver. Deglutition. Movements of alimentary canal and their regulations. Composition, functions and regulation of
the secretion of salivary, gastric, pancreatic and intestinal juices and bile.Synthesis of Bile acids. Enterohepatic
circulation. Digestion and absorption of carbohydrates, lipids, proteins and nucleic acids. Defecation. Feces.
GALT. Basic concepts of Peptic Ulcer, Jaundice and Gall-stones.**[2 Credits](24 Lectures)**

Vitamin and minerals

Vitamins: Thiamin, Riboflavin, Niacin, Pyridoxine, Pantothenic Acid, Biotin, Cyanocobalamin, Folic Acid,
Ascorbic Acid, Inositol. Vitamins A, D, E and K. Chemistry, dietary sources, daily requirements, biochemical
roles and functions, deficiency symptoms, hypervitaminosis, antivitamins. Minerals: Sources, biological functions,
metabolism and regulation of sodium, potassium, calcium, phosphorus, iron, zinc, iodine and fluoride.**[1 Credits](24 Lectures)**

Molecular Biology :

DNA replication—Meselson and Stahl Experiment, DNA Polymerases, Ligases and other regulatory proteins.
Transcription -- RNA Polymerase and other regulatory mechanism in prokaryotes. Genetic code – properties and
wobble hypothesis. Translation – codon-anticodon interaction and mechanism in prokaryotes. Regulation of gene
expression : operon concept – the lac operon. Gene mutation – agents and types. DNA repairing processes. Concept
of oncogenes and properties of cancer cells. Elementary idea of recombinant DNA technology and its applications
– gene therapy, transgenic animal. Northern and Southern blotting. **[1 credit] (12 Lectures)**

Core Course-VI Practical [2 Credits]

Blood Biochemistry

i) Blood Sugar by Folin-Wu Method ; ii) Serum Protein by Biuret Method ; iii) Serum Albumin using Bromocresyl Green ; iv) Estimation of RNA by orcinol method ; v) Blood Uric Acid by cyanide-free method ; vi) Serum urea by DAM method.

Core Course VII: Nervous System and Skin [4 Credits]

Nervous System

A brief outline of organization and basic functions (sensory, motor and association) of the nervous system (central and peripheral). Structural organization of different parts of brain and spinal cord. Reflex action – definition, reflex arc, classification and properties. Autonomic nervous system : organization, outflow, ganglia, centers and functions. Chemical transmission in autonomic nervous systems. Central control of autonomic nervous system. CSF: formation, circulation and functions. Blood-CSF and Blood-Brain barrier.
Ascending and descending tracts : origin, courses, termination and functions.
Lower per motor neurones. Functions of the spinal cord with special reference to functional changes following hemisection and complete section of spinal cord – Brown-Sequard syndrome. Spinal animal. Pain production, perception and regulation. Referred pain.

Decerebrate rigidity, decorticate rigidity. Postural reflexes. Muscle spindle and golgi tendon organ: their structure, innervations and functions, regulation of muscle tone. Structure, connections and functions of cerebellum. Structure and functions of vestibular apparatus. Nuclei, connections and functions of thalamus and hypothalamus. Basal nuclei : structure, connections and functions. Cerebral cortex : histological structure, localization of functions.
Limbic system: structure, connections and functions. Physiology of emotion.
Electrophysiology of brain: spontaneous electrical activity of brain, EEG and ECoG, evoked potential, DC potential. Isolated cortex. Higher functions of nervous system: conditioning, learning and short-term and long-term memory. Speech. Aphasia. Asymmetrical organization of certain cognitive functions-split brain. Reticular formation: organization, connection and functions of ascending and descending reticular formation. Physiological basis of sleep and wakefulness.
[3 Credits] (36 lectures)

Skin and Body Temperature Regulation :
Structure and functions of skin. Cutaneous circulation. Sweat glands –structure and composition of sweat. Sweat formation, secretion and its regulation. Insensible perspiration. Regulation of body temperature in homeotherms – its physical and physiological processes, roles of neural and hormonal processes. Pyrexia, hyperthermia and hypothermia.**[1 Credit] (12 lectures)**

Core Course-VII Practical [2 Credits]
Histology – Sectioning and staining
Staining of sections by haematoxylin-eosin and iron-haematoxylin.
Demonstration: Preparation of permanent slides – fixation, dehydration, paraffin embedding, block preparation, cutting and staining.

SEMESTER III

GE III : Gastrointestinal Physiology (4 credit)
Digestive system,
Anatomy and histology of alimentary canal. Digestive glands – histological structures of salivary glands, pancreas, liver. Deglutition. Movements of alimentary canal and their regulations. Composition, functions and regulation of the secretion of salivary, gastric, pancreatic and intestinal juices and bile.Synthesis of Bile acids. Enterohepatic circulation. Digestion and absorption of carbohydrates, lipids, proteins and nucleic acids. Defecation. Feces.
GALT. Basic concepts of Peptic Ulcer, Jaundice and Gall-stones. Brief idea about Xerostomia, Chorda Tympani Syndrome, Sjogren syndrome, Gastritis, Gastric Atrophy, Zollinger – Ellison Syndrome, Pancreatitis, Steatorrhea, Jaundice, Hepatitis, Chirrosis of Liver, Malabsorption syndrome, Crohn's disease or Enteritis, Diarrhea, Constipation, Appendicitis, Ulcerative Colitis, Belching.

GE III : Lab (Credit : 2)
Hematological experiments :
Preparation and staining of blood film with Leishman's stain. Identification of blood corpuscles.Differential count of WBC. Total count of RBC and WBC. Haemoglobin estimation. Preparation of haemin crystals. Blood group

determination.

B.Sc. Physiology (Honours)
Semester III

Skill Enhancement Course (SEC-I)
Unit 1: Preparation of Diet Chart for Children, Adult and Pregnant Women.
Unit 2: Interpretation of ECG Records.

Semester IV

Core Course-VIII: Sensory Physiology [4 credits]

Sensory receptor and Olfaction

Classification of general and special senses. Receptors as biological transducers. Muller's law of specific nerve energies. Weber-Fechner law, Steven's power law. Sensory transduction in Pacinian corpuscle. Adaptation of receptors – phasic and tonic adaptations.

Olfaction and Gustation : Structure and functions of the receptor organs , nerve pathways, centers. Properties of olfactory and gustatory sensation and their transduction & coding.Electro-olfactogram. Abnormalities of olfactory and taste sensation.**[1 credit] (12 Lectures)**

Vision

Structure of the eyeball. Structure of lens. Cataract .Formation, circulation and functions of aqueous humour, glaucoma. Mechanism of accommodation. Pupillary reflexes light reflex, near response. Argyll- Robertson pupil.

Errors of refraction and their corrections. Histological details of retina, peripheral retina, fovea and blind spot.

Retinal detachment. Visual pathway and centers. Effects of lesion in visual pathway. Photopic and scotopic vision.

Chemical and electrical changes in retina on exposure to light. Visual processing in the retina. Electroretinogram.

Positive and negative after- images. Contrast phenonmenon. Light and dark adaptation. Colour vision and its modern concept. Colour blindness.Visual field-- perimetry. Visual acuity – measurement, mechanism and factors affecting.

Critical fusion frequency.

[2 credits] (24 Lectures)

Audition

Sound waves, decibel. Structure and functional significance of auditory apparatus – external, middle and internal ears. Organ of Corti .Auditory transduction. Auditory pathways and centers. Mechanism of hearing and its modern theories. Different electrical potentials of internal ear. Discrimination of sound frequency and loudness.Localization of sound source. Audiometry. Deafness. **[1 credit] (12 Lectures)**

Core Course-VIII Practical[2 credits]

Dales Experiments – studies on smooth muscle

Kymographic recording of normal movements of rat's intestine in Dale's apparatus.

Effects of hypoxia, acetylcholine and adrenaline on normal intestinal movements.

Core Course IX: Instrumentation, Biostatistics and Environment [4 credits]

Instrumentation and computer

Principles of construction and uses of compound microscope, phase contrast microscope, fluorescence microscope,
polarizing microscope, confocal microscopy, transmission and scanning electron microscope, photoelectric colorimeter. Brief idea of CRO, CT scan, fMRI and PET.
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
[1 credit] (12 Lectures)

Biostatistics

Scope of statistics – utility and misuse.Principles of statistical analysis of biological data. Basic concepts – variable,
parameter, statistics. Sampling. Presentation of data-frequency distribution, frequency polygon, histogram, bar
diagram and pie diagram. Parameters. Different classes of statistics- mean, median, mode, mean deviation, variance,
standard deviation, standard error of the mean. Standard score. Degrees of freedom. Probability. Normal distribution.
Student's t-distribution. Testing of hypothesis - Null hypothesis, errors of inference, levels of significance, t-test and
z score for significance of difference. Distribution-free test - Chi-square test. Linear correlation and linear regression.**[1.5 credits] (18 Lectures)**

Human and environment

Environment – Physical and biological aspects. Effects of exposure to hot and cold environment. Acclimatization
to hot and cold environment. Heat disorders and its preventive measures. Effects of hypobaric and hyperbaric
environment. Caisson disease. Preventive measure for hypobaric and hyperbaric effects. Acclimatization to high
altitudes.
G force, ionizing and non-ionizing radiations - physiological effects and preventive measures. Air, noise and water
pollutions – causes, effects, prevention measures and control. Brief idea of the hazards of pesticides, carcinogens,
mutagens, neurotoxins and war gases. Impact of green house effects on life
[1.5 credits] (18 Lectures)

Core Course-IX Practical[2 credits]

Human experiments

a) Sphygmomanometric measurement of arterial blood pressure at rest and after exercise.
b) Modified Harvard step test and determination of physical fitness. Recording of recovery heart-rate after standard
exercise and graphical plotting.
c) Pneumographic recording of effects of talking, drinking, laughing, coughing, exercise, hyperventilation and breath
- holding.
d) Spirometric measurement of vital capacity.
e) Measurement of some common anthropometric parameters- stature, weight, eye height, shoulder height, eye
height (sitting), elbow height, sitting height, elbow rest height (sitting), knee height (sitting), shoulder elbow
length, arm reach from wall, elbow-to-elbow breadth, knee-to-knee breadth (sitting), shoulder breadth, head

length, head breadth, head circumference and neck circumference, mid-arm circumference, waist circumference,
hip circumference, chest circumference.

Core Course X : Metabolism and Microbiology [4 Credits]

Biological oxidation and carbohydrate metabolism

Biological oxidation – Redox Potential, Mitochondrial Electron Transport Chain, Oxidative Phosphorylation –
Inhibitors and uncouplers.
Carbohydrate - Glycolysis, R-L cycle, TCA cycle, Gluconeogenesis - Cori cycle, Glucose-Alanine cycle.Anaplerotic reactions and Amphibolic nature of TCA cycle. Pentose Phosphate Pathway. Glycogenesis and
Glycogenolysis. *Hormonal regulation of the above mentioned biochemical pathways/cycle not require.***[1 credit]**
(12 Lectures)

Metabolism of amino acid and purine and pyrimiidine

Amino acids - Amino acid pool. Deamination, transamination, amination and decarboxylation. Synthesis of Urea and
Nitric oxide. Basic idea of glucogenic and ketogenic amino acids. Metabolism of glycine, sulfur-containing amino
acids, tryptophan and phenylalanine.
Purines and Pyrimidines – Biosynthesis : *de novo* and salvage pathways. Catabolism.
(Regulation of the above mentioned biochemical pathways/cycle not required.)
[0.5 credits] (8 Lectures)

Lipid metabolism and reactive oxygen species

Lipid -- β-oxidation and biosynthesis of saturated and monounsaturated fatty acids. Metabolism of Triglycerides.
Biosythesis of Lecithin, Cephalin and Cholesterol. Metabolism of Adipose Tissue.Role of lipoproteins in transport
and storage of lipids.
Formation of Reactive Oxygen Species and the role of Catalase, Superoxide Dismutase, Glutathione Peroxidase
and Glutathione Reductase in combating oxidative stress – role of vitamins. (*Hormonal regulation of the above
mentioned biochemical pathways/cycle not required.)*
[0.5 credits] (8 Lectures)

Methodologies :

Chromatography: Principles and uses of : TLC, Gel filtration, Affinity chromatography ion-exchange chromatography. Electrophoresis: Principles and method, uses of Agarose gel electrophoresis, SDS – PAGE.
Ultracentrifugation: moving boundary and density gradient ultracentrifugation. Radioactivity – Classification and
properties. Their use – radiolabelling of biomolecules and its detection by autoradiography. Principles of radioimmunoassay (RIA),ELISA. Immunoblotting.
[1 credit] (12 Lectures)

Microbiology

Bacterial prokaryotic cell. Classification of bacteria on the basis of morphology and staining characteristics – Gram staning, spore staining and acid-fast staining. Bacterial nutritional requirements, nutritional types, culture media, physical conditions for growth. Growth curve of bacteria. Bacterial metabolism- fermentation, glyoxylate cycle, Entner-Doudoroff pathway. Bacterial genetics, transformation, conjugation and transduction. Sterilization and pasteurization. Elementary idea of bacteriostatic and bactericidal agents viz. phenols, alcohol and antibiotics.
Elementary knowledge of virus:morphology, viral genome & classification. **[1 credit] (12 Lectures)**

Core Course-X Practical [2 credits]
Experiments on Microbiology
(a) Gram staining of bacteria and identification of Gram positive and Gram negative bacteria. Demonstration: Spore Staining, Immuno-diffusion.
(b) Isolation of amino acids from an artificial mixture using paper chromatography.

GENERIC ELECTIVE –IV: Cardio- Respiratory System [4 Credits]
Cardiovascular system I
Cardiovascular system-Anatomy and histology of the heart. Properties of cardiac muscle. Origin and propagation of cardiac impulse. Cardiac cycle :events. Heart sounds. Heart rate.Cardiac output: methods of determination (dye dilution and Fick principle), factors affecting,regulation.
[1Credit] (12 lectures)
Cardiovascular system II
Structure of arteries, arterioles, capillaries. venules and veins. Pulse - arterial and venous. Blood pressure and its regulation andfactors controlling. Baro- and chemoreceptors. Vasomotor reflexes. Methods of measurement of blood pressure. Peculiarities ofregional circulations: coronary, pulmonary, renal, hepatic and cerebral.
[1Credit] (12 lectures)
Respiratory System
Anatomy and histology of the respiratory passage and organs. Role of respiratory muscles in breathing.
Artificial respiration.Significance of physiological and anatomical dead space. Lung volumes and capacities. Exchange of respiratory gases betweenlung and blood and between blood and tissues. Transport of oxygen and carbon dioxide in blood. Regulation of respiration -neural and chemical. Hypoxia.
[2 Credits] (24 lectures)

GE-IV Practical (Lab) [2Credits]
Human experiments
f) Sphygmomanometric measurement of arterial blood pressure at rest and after exercise.
g) Modified Harvard step test and determination of physical fitness. Recording of recovery heart-rate after standard exercise and graphical plotting.
h) Pneumographic recording of effects of talking, drinking, laughing, coughing, exercise, hyperventilation and breath
- holding.

B.Sc. Physiology (Honours)
Semester IV

Skill Enhancement Course (SEC-II)
Unit 1: Data Analysis and representation of Physiological data- Bar Diagram, Pie Diagram, Computation of Data- Mean, Median and Mode.
Unit 2:Basic Application of Computer in Physiological data Analysis – M.S. Word and M.S. Excel.

Semester V

Core Course-XI: Endocrinology [4 credits]

Endocrinology :

i. Classification of endocrine glands and hormones. Methods of study of endocrine functions. Hypothalamus as a neuroendocrine organ. Anterior and posterior pituitary -- histological structure of the gland. Chemical nature, mode of action, functions and regulation of secretion of their hormones. Hypo- and hyperactive states of the gland. Pineal gland – histological structure. Chemical nature, biosynthesis, mode of actions, functions and regulation of secretion of melatonin. **[1 Credit]**(**12 Lectures**)

ii. Thyroid and parathyroid -- histological structure of the glands. Chemical nature, mode of action, functions and regulation of secretion of the hormones. Hypo- and hyperactive states of the glands. Thymus -- histological structure of the gland. Chemical nature, mode of action and functions of thymic hormones.**[1 Credit](12 Lectures)**

iii. Adrenal cortex and medulla -- histological structure of the gland. Chemical nature, mode of action, functions and regulation of secretion of the hormones. Biosynthesis and catabolism of catecholamines. Hypo- and hyperactive states of the gland. Heart as an endocrine organ. Prostaglandins and Kinins. **[1 Credit]**(**12 Lectures**)

iv. Pancreatic islets -- histological structure. Chemical nature, mode of action, functionsand regulation of secretion of the hormones. Hormonal control of blood sugar. Hyperinsulinism and diabetes mellitus. Growth factors –EGF, TGF, PDGF, IGF and FGF.Chemical nature, mode of action, functions. Gastro -intestinal hormones -- Chemical nature, mode of action, functions and regulation of secretion of the hormones. **[1 Credit]**(**12 Lectures**)

Core Course-XI Practical [2 Credits]

Diet survey

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

Core Course XII: Reproductive Physiology and Immunology [4 Credits]

Reproductive Physiology:

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

and their hormonal control.**[2Credits](24 Lectures**)

Embryology

Basic concepts of stem cells : Totipotency, Differentiation - Committed stem cell. Fertilization, Blastulation,
Implantation,Gastrulation, Placentation. Development of alimentary canal, heart, urinary system and genital
system. Foetal circulation. Ossification of bone.

[0.5 Credit](8 Lectures)

Immunology: Immunity: Definition, innate immunity,mechanical barrier against pathogenic organism. Antibacterial & antifungal substances in external body secretions, bacteriocidal actions of HCL, inflammatory responses & its role in body defences, chemotaxis & phagocytosis, lysozyme, role of phagocytes. Acquired immunity,active immunity & passive immunity. Humoral & cell mediated immunity, primary & secondary immune responses. Mechanisms of humoral immunity, antigens, haptens B- lymphocytes, plasma cells, Classification & molecular structure of immunoglobulins , antigen- antibody reactions & their effects. MAB – complements, classification of complements & their activation, function of complements,. Mechanisms of cell mediated immunity. T- lymphocytes, suppressor, helper & killer T cells. Cytotoxic & cytolytic effects of T cells. T- cell B- cell cooperation. Role of macrophages in cell mediated immunity. Cytokines & lymphokines. Antitoxins, interferons, hypersensitivity reaction, anaphylaxis, their effects & examples in the human system. Blood groups, antigens & serum agglutinins. Human leucocyte antigens, autoimmunization. Autoimmune diseases of thyroid & kidney & muscle, AIDS, tumor immunology. ELISA test. [**1 Credit](12 Lectures)**

Chronobiology :

Different types of physiological rhythms – ultradian, circadian, infradian. Different zeitgebers and their relation with circadian clock. Hormonal biorhythms and their significance: adrenocortical, pineal and prolactin.
Body temperature rhythm. Neural basis of biological clock and role of suprachiasmatic nuclei. Sleep wakefulness
cycle.Time keeping genes. Jet-lag and shift work.

[0.5 Credit](8 Lectures)

Core Course-XII Practical [2Credits]

Experiments on Biostatistics

Computation of mean, median, mode, standard deviation and standard error of the mean with physiological data like body temperature, pulse rate, respiratory rate, height and weight of human subjects. Graphical representation of data in frequency polygon and histogram. Student's t test for significance of difference between means.
Demonstration: Statistical analysis and graphical representation of biological data with computer application program (Microsoft Excel).

DSE I [4 Credits]: Pharmacology

The importance of pharmacology in the study of physiological processes. Definition of drug, agonist and antagonist. Drug delivery. Pharmacokinetics : Absorption, Distribution, Permeation, Elimination, Clearance,Halflife.
Pharmacodynamics:dose-response curves. Drug biotransformation. Bioavailability. Drug accumulation. Drug
toxicity – LD50, ED50, therapeutic index.
Anaesthetics : types and mechanism of action of general anaesthetics. Sedatives - hypnotics: benzodiazepine,
zolpidem.
Diuretics - Carbonic anhydrase inhibitor, loop diuretic, potassium sparing and osmotic diuretics.

Neuromuscular blockers: Tubocurarine and succinyl choline.
Organ system effects and mechanism of action of adrenoceptor agonists and antagonists: *Adrenergic stimulants*
: Amphetamine and ephedrine.α- adrenergic stimulants – Methaxomine and clonidine. β- adrenergic stimulants –
Metaproterenol and salbutamol. *Adrenergic antagonists* : Labetelol.α- adrenergic blockers – Phenoxybenzamine and
phentolamine. β- adrenergic blockers – Propranolol and atenolol. Antianginal drugs : Nitroglycerine and calcium channel
blocker – Nifedipine and verapamil.
Nonsteroid antiinflamatory drugs**[4 Credits] (48 Lectures**)

DSE I Lab Tutorial [2 credits]

1. Dose response curve of oxytocin on uterine muscle tone
2. Dose response curve of adrenaline intestinal smooth muscle
3. Pentobarbital sleeping time in rat /mice – assessment of amphetamine and benzodiazepine action
4. Effect of sedative and stimulant drug (amphetamine and benzodiazepine etc) on locomotor activity on open field
5. Effect of antidepressant drug on Forced swim test in rats

DSE II [4 Credits]

Community health

Definition & concept of health and diseases, dimension of health, health system, Diseases: causation and prevention of diseases, mode of intervention, epidemic and endemic forms of diseases, physiologists as health
counsellors
Epidemiological triad, web of causation, high - risk group, prevention of communicable diseases, prevention of non -
communicable diseases, drug abuse and addiction, drug metabolism and detoxication
Nutrition in infancy: Nutritional requirements of nutrients during infancy. Breast feeding – nutritional and others
factors, advantages, problems in breast feeding, Infant milk substitute (IMn S) act 1992. Formula feeding, Vitamin
and mineral supplementation – vit –D, Iron, Fluoride, Supplementary foods of milk, cow's milk, goat's milk,
vegetarian beverages, fruit juice. Nursing caves; solid supplements wearing, Nutritional requirement of pre- term
babies; Feeding problems – food allergies, cow's milk protein allergy, lactose intolerance, diarrhea, constipations
vegetarianism
Nutrition in childhood and adolescence: Nutritional requirement of pre-school and school children, monitoring
growth and development. Nutrition related problems of children- childhood obesity, dental caries, allergies,
deficiency of Vit-A- aetiology, symptoms, prevention. Nutritional requirement and problem of adolescents-Anorexia
nervosa, Bubnia nervosa, Binge eating disorder, premenstrual syndrome.
Nutrition in pregnancy: maternal factors effecting pregnancy outcome: maternal age, pre-pregnant weight, weight
gain during pregnancy, life style factors. Birth weight standards,Low birth weight baby. Nutritional requirements
during pregnancy. Problems in pregnancy- morning sickness, nausea and vomiting, constipation, oedema and leg
cramps, Heart burn, excessive weight gain. Complication- anemia, toxemia, Diabetes mellitus

Nutrition in lactating women: Nutritional requirements, Factors affecting the volume and concentration of breast
milk
Protein energy malnutrition:- PEM- symptoms, nutritional requirement in dietary management.
Nutritional anemia:-Prevalence, Iron metabolism, Iron absorption enhancers and inhibitors, Clinical features &
management of Iron deficiency anemia, Megaloblastic anemia.
Cardiovascular disorders-Coronary heart disease (CHD): food and nutrients in CHD. Cardiovascular risk factors
and nutritional management of CHD, Hypertension: Diet and blood pressure.
Diabetes mellitus-Dietary management of Diabetes mellitus – nutritional requirements, glycaemic index, Com plication
of diabetes – hypoglycaemia and insulin shock, ketoacidosis.
Nutrition promotion in community: causes and consequences of malnutrition in India.Community based intervention programmes – Mid – day – meal for school children. Specialnutrition programme (SNP) Integrated child
development services (ICDS), National Nutritional Anaemia control programmes, Vit – A prophylaxis programme,
National Iodine deficiency disorder control programme public distribution system. Targeted public distribution
Nutrition and aging: Process of aging, changes in organ function with aging, nutritional requirement, nutrition
related problems in old age- osteoporosis, anemia, obesity, constipation, malnutrition. Antioxidants in the health of
old age
Overweight and obesity:- prevalence, factors – environmental and life style factor, food intake, Genetic factors.
Obesity management. Underweight – Aetiology and management.
[4 Credits] (48 Lectures)

DSE II Lab (2 Credits)
Preparation of diet chart for the following:
i. adolescents,
ii. pregnant and lactating women,
iii. elderly humans,
iv. athletes

Semester VI

Core Course XIII: Social Physiology and Nutrition [4 credits]
Social Physiology:
Population problem – principles and methods of family planning, Problem of infertility and Assisted Reproductive Technologies. Malnutrition – PCM, marasmus, kwashiorkor, marasmic kwashiorkor, endemic
goiter, nutritional anemias, rickets, osteomalacia, xeropthalmia, beriberi and their social implications. Principles and social importance of immunization against diseases. Epidemiology and prevention of cholera,
malaria, hepatitis and AIDS **[1.5 credits](18 Lectures)**
Nutrition and Dietetics :
Constituents of food and their significance. Basal metabolic rate - factors, determination by Benedict-Roth apparatus. Respiratory quotient. Specific dynamic action. Calorific value of foods. Body calorie requirements
– adult consumption unit. Dietary requirements of carbohydrate, protein, lipid and other nutrients. Food

groups, Food exchange tables.. Balanced diet and principles of formulation of balanced diets for growing child,
adult man and woman, pregnant woman and lactating woman. Nitrogen balance, essential amino acids, biological value of proteins – measurement and factors affecting. Proteinssparers. Supplementary value of protein. Protein efficiency ratio and net protein utilization of dietary proteins. Dietary fibres. Principle of diet
survey. Composition and nutritional value of common food stuffs. Physiology of starvation and obesity **[2.5 credits](30 Lectures)**

Core course XIII practical [2 Credits]

Nutritional status and growth

1. Growth monitoring and nutritional assessment: assessment of nutritional status of boys and girls of different
ages of a community (2 to 20 years) from standard stature for age, and weight for age curves.
2. Identification of growth spurt of adolescents
3. Determination of grades of malnutrition of children by Gomez classification and waterloos classification.
4. Assessment of nutritional status from height – vs – weight of adult male and female.
5. Assessment of nutritional status from measurement of food intake by 24 – hour recall method and food frequency questionnaire method.
6. Assessment of nutritional status from anthropometric measures from MUAC, head circumference and anthropometric indices such as BMI, Waist – Hip ratio.
7. Assessment of nutritional status from clinical observation / nutrient deficiency symptoms

Core course XIV: Ergonomics and Sports Physiology [4 credits]

Work Physiology and Ergonomics:

Physical work—its definition and nature—isotonic, isometric and isokinetic, positive and negative work. Concept of
physiological work. Power and capacity relation. Work -load – light, moderate(submaximal) and heavy (maximal)
depending on intensity and duration of work. Exercise inducing equipment – bicycle ergometer, treadmill and
stepping stool. Energetics of work – sources of energy and energy demand for different activities. Assessment of
energy cost of various physical work – direct and indirect methods with their limitations. Physiological responses to
work – cardiovascular, respiratory, metabolic and muscular – short- term and long-term. Work-rest cycle and
importance of rest pause. Basic concept of ergonomics and its application in industry to improve efficiency and
industrial safety as well as to restrict occupational health hazards. Anthropometry and its implication in ergonomics
in general. **[2.5 credits] (35 Lectures**)

Sports Physiology:

Concept of endurance, strength and speed in sports activities. Physical training – principles and their impact on performance level in sports with reference to cardiovascular, respiratory and muscular changes. Overtraining and detraining. Warm up and cool down. Brief general idea about nutritional aspects of sports. Aerobic and anaerobic power—concept, factors affecting, methods of measurement and significance of maximal oxygen consumption and excess post exercise oxygen consumption. Lactate threshold, lactate tolerance and their usefulness. Concept of recovery processes and occurrence of fatigue in physical work. Ergogenics aids. Concept of physical fitness and its assessment **[1.5 credits] (20 Lectures)**

Core Course XIV practical [2 credits]
Project
Students are required to submit a project report on (a) or (b).
(a) On the basis of field survey / laboratory work under the guidance of a teacher. The field survey / laboratory studies should be carried out by assessing any one from the followings:
1. Diet survey report of a family (as per ICMR specification)
1. Physiological parameters of humans (at least three parameters).
2. Anthropometric parameters on humans (at least three parameters).
3. Epidemiological studies on humans.
4. Physiological parameters of animals(at least three parameters).
(b) A report may be submitted on the visit to Institute of national importance engaged in physiological, biomedical, biochemical and nutritional research.

DSE III [4 credits]
Environment and Stress Physiology
Ecosystem – structure and function, different types of ecosystem, food chains, food webs and energy flow and mineral cycling in ecosystems; primary production and decomposition , Biogeochemical cycle. Global environmental problems: global climate change ,ozone layer depletion, the green house effect, global warming and its consequences.Eutrophication, waste water or sewage treatment. Water quality criteria, standards. Safe drinking water act.Wetland and its importance.
Space physiology- physiological adjustments in humans due to prolonged exposure in space, nutritional requirements of astronaught , special health problems in space, preventive measures of health hazards of astronaughts
High altitude physiology-, respiratory problems in high altitude, pulmonary hypertension, adaptation in highland dwellers Ionizing and nonionizing radiation- effects on different physiological systems xenobiotics and their effects
Heat stress- physiological and molecular changes in heat stress, pre vention of heat stress
Stress Physiology – Physiological change in stress, Homeostasis in stress, Oxidative and nirosative stress – mechanism, management of stress
[4 credits](48 Lectures)

DSE III LabTutorial [2 credits]
i) Measurement of environmental temperature - dry bulb and wet bulb, relative humidity, air velocity.
ii) Determination of O2, CO2, BOD and COD. Determination of total alkalinity, Ca, Mg and chlorine in water by titration method,

DSE IV [4 credits]
Occupational health
Occupational Health – definition, factors affecting occupational health. Occupational health hazards –(i) Occupational hazards in work place – mechanical , chemical, biological, fire, toxic substances, and Explosive materials ,(ii) Environmental hazards – Heat stress, cold stress, noise, vibration, ultra-violet radiation. Occupational safety and health – concept of health and safety; Accidents – theories of accident, effect on i ndustry; promotion of safety, health and safety training, personal protective devices Occupational diseases – Pneumoconiosis, silicosis, asbestosis, Occupational cancer – skin, lungs, urinary bladder, Occupational health problem of agricultural workers Prevention and health measures of occupational hazards – nutrition, disease control, environmental sanitation, medical measures, ergonomic measures, legislation Occupational stress – causes, evaluation of stress, management of stress

[4 credits](40 Lectures)

DSE IV lab [2 credits]

1. Assessment of Musculoskeletal disorder by questionnaire technique
2. Lung function tests – FEV , FVS, Peak flow rate
3. Assessment of pulmonary disorder by questionnaire method
4. Measurement of noise by Sound level meter.
5. Measurement of illumination level by luxmeter

B.Sc. Physiology (Program)

Semester I

Core Course I (DSC1A): Biophysics ,Biochemistry and Digestion [4 credits]

Cellular Physiology and Biophysical Principles

Membrane physiology: structure and functions of cell and subcelluar membranes, cytoskeletal system , cell junctions and cell adhesion molecules, Physicocemical principles and Physiological importance of : Diffusion , Osmosis, Dialysis, Ultrafiltration , Surface tension, Adsorption , Absorption, pH and buffers,

Colloids. Enzymes - classification, coenzymes, factors affecting enzyme action, regulation of enzymes- feedback, covalent and allosteric. Isozymes and nonprotein enzymes**[1.5 credits](18 Lectures)**

Biochemistry and Metabolism :

Carbohydrates **:** classification , structure and properties *Proteins* **:** Classification , order of structure (elementary idea), Amino acids**:** classification and properties *Lipids :*classification. Fatty acids – Classification, and properties , lipoprotein – Classification and structure *Nucleic acid* – structure of DNA and RNA

Vitamins – classification and functions. *Minerals* – functions of Sodium, Potassium , Calcium , Phosphorus, Iron, Zinc , Iodine and Fluoride.

Metabolism – Glycolysis, TCA cycle, Glycogenesis, Glycogenolysis. Gluconeogenesis. , Beta oxidation of saturated fatty acid , Ketone bodies – formation and significance. Deamination, Transamination. Amino acid pool, Urea cycle, vitamins in metabolism **[1.5 credits](18 Lectures)**

Digestive System:

Alimentary cana1 and digestive glands – Structure in relation to functions . Composition, functions and regulation of secretion of digestive juices including bile. Digestion and absorption of carbohydrate, protein and lipid. Movements of the stomach and small intestine

[1 credit](12 Lectures)

Core Course I (DSC1A) Practical [2 credits]

3. Fresh tissue experiments:

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

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

f) Staining of adipose tissue by Sudan III or IV

4. Identification of permanent slides:

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.

Semester II

Core Course-IV : DSC 1B: Nerve-Muscle Physiology and Hematology [4 Credits]

Nerve-muscle physiology

Different types of muscle and their structures. Ssarcotubular system. Red and white muscles. 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.

Mechanism of muscular contraction. Structural, chemical and mechanical changes in skeletal muscle during contraction and relaxation. Isotonic and isometric contraction.

Structure and classification of nerves. Degeneration and regeneration of nerve fibre. Myelination. Origin and 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, indefatigability. 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 neurotransmitters.

[1.5 Credit] (18 lectures)

Blood, body fluid and immune system

Blood: composition and functions. Plasma proteins: origin and functions. Plasmapheresis. Bone marrow. Formed elements of blood - their morphology and functions. Erythropoiesis and leucopoiesis.

Haemoglobin **:** different types of compounds and derivatives. Blood volume and its determination (dye method and radioisotope method) and regulation. Coagulation of blood - mechanism, factors affecting, procoagulants, anticoagulants, and disorders of coagulation.

Lymph and tissue fluids: composition, formation, and functions

Immune system: Overview of Innate and acquired immunity. Immunigens and antigens. Antibody: structure and classification. Brief idea of auto-immunity and Aids. Vaccination: passive and active immunization, Toxins and toxoids

[1.5 Credits] (18 lectures)
Cardiovascular system I
Cardiovascular system-Anatomy and histology of the heart. Properties of cardiac muscle. Origin and propagation of cardiac impulse. Cardiac cycle :events. Heart sounds. Heart rate.Cardiac output: methods of determination (dye dilution and Fick principle), factors affecting,regulation
[1Credit] (12 lectures)

Core Course-IV Practical (DSC 1B Lab) [2Credits]
Biochemistry
Qualitative Experiments:
Qualitative tests for identification of starch, dextrin, lactose, sucrose, glucose, fructose, albumin, gelatin, peptone, lactic acid, hydrochloric acid, acetone, glycerol, bile salts, urea.
Quantitative Experiments:
c) Quantitative estimation of glucose by Benedict's method.
d) Quantitative estimation of amino-nitrogen by Sorensen' s formol titration method.
(Percentage and total quantity to be done).

Semester III

Core Course-VII: DSC 1C: Cardio-Respiratory and Excretory System [4 Credits]
Cardiovascular system II
Structure of arteries, arterioles, capillaries. venules and veins. Pulse - arterial and venous. Blood pressure and its regulation andfactors controlling. Baro- and chemoreceptors. Vasomotor reflexes. Methods of measurement of blood pressure. Peculiarities ofregional circulations: coronary, pulmonary, renal, hepatic and cerebral.
[1Credit] (12 lectures)
Respiratory System
Anatomy and histology of the respiratory passage and organs. Role of respiratory muscles in breathing. Artificial respiration.Significance of physiological and anatomical dead space. Lung volumes and capacities. Exchange of respiratory gases betweenlung and blood and between blood and tissues. Transport of oxygen and carbon dioxide in blood. Regulation of respiration -neural and chemical. Hypoxia.
[1.5 Credits] (18 lectures)
Excretory system and skin
Relationship between structure and functions of kidney. Mechanism of formation of urine. Normal and abnormal constituents of urine. Physiology of urine storage and maturation. Renal balance. Non-excretory gulation of acid-base functions
of kidney. Structure and functions of skin. Insensible and sensible perspiration Regulation of body temperature -- physical and physiological processes involved in it. Physiology of sweat secretion and its regulation.
[1.5 Credits] (18 lectures)

Core Course-VII Practical :DSC 1C Lab
Hematology
a) Leishman's staining of human blood film and identification of different types of blood corpuscles.
b) Preparation of Haemin crystals.

B.Sc. Physiology (Program)
Semester III

Skill Enhancement Course (SEC-I)
Unit 1: Preparation of Diet Chart for Children, Adult and Pregnant Women.
Unit 2:Interpretation of ECG Records.

Semester IV

Core Course X: DSC 1D: Sensory, Endocrine and Reproductive Physiology [4 credits]
Sensory physiology
(a) Classification of general and special senses and their receptors. Receptors as biological transducer.
(b) *Olfaction and Gustation:* Structure of sensory organ, neural pathway of olfactory and gustatory sensation. Physiology ofolfactory and gustatory sensation. Olfactory and gustatory adaptation. After taste.
(c) *Audition:* Structure of ear, auditory pathway, mechanism of hearing.
(d) *Vision:* Structure of the eye. Histology of retina. Visual pathway. Light reflex. Chemical changes in retina on exposure tolight. Accommodation - mechanism and pathway. Errors of refraction. Positive and negative after-image. Light and dark adaptation. Elementary idea of colour vision and colour blindness.
[1.5 Credits] (18 lectures)
Endocrine system
Anatomy of endocrine system. Hormones - classification. Basic concept of regulation of hormone actions. Positive and negative feedback mechanism. Elementary idea of hormone action.
Hypothalamus : Basic concept of neurohormone. Hypothalamo-hypophyseal tract and portal system.
Pituitary: Histological structure, hormones, functions. Hypo and hyperactive states of pituitary gland.
Thyroid: Histological structure. Functions of thyroid hormones ($T_4$$T_3$) Thyrocalcitonin. Hypo and hyperactive states of thyroid. *Parathyroid:* Histological structure, functions of parathyroid hormone. Tetany.
Adrenal Cortex: Histological structure and functions of different hormones. Hypo and hyper-active states of adrenal cortex.Primary and accessory sex organs and secondary sex characters. Testis: histology, spermatogenesis, testicular hormones and their functions. Ovary: histology, oogenesis, ovarian hormones and their functions. *Pancreas:* Histology of islets of Langerhans. Origin and functions of pancreatic hormones. Diabetes mellitus. Brief idea of the origin and functions of renin-angiotensin, prostaglandins. erythropoietin and melatonin. Elementary idea of gastrointestinal hormone. (12 lectures)
[1.5 Credits] (18 lectures)
Reproductive Physiology :
Primary and accessory sex organs and secondary sex characters. Testis: histology, spermatogenesis, testicular hormones and their functions. Ovary: histology, oogenesis, ovarian hormones and their functions. Oestrus and menstrual cycles and their hormonal control. Fertilization, implantation and structure and functions of placenta. Maintenance of pregnancy – role of hormones. Development of mammary gland and lactation - role of hormones. sympatheticnervous system.
[1Credit] (12 lectures)

Core Course-X Practical: DSC 1D Lab
Human Experiment
a) Determination of heart rate and breathing rate during rest and exercise.
b) Pneumographic recording of respiratory movements along with the effect of drinking of water, talking, forced hyperventilation and breath holding.
c)Measurement of systolic and diastolic arterial pressure by sphygmomanometer and determination of pulse pressure and mean pressure during rest and exercise.
d)determination hemoglobin concentration by hemoglobinometer
e) measurement of visual acuity

B.Sc. Physiology (Program)

Semester IV

Skill Enhancement Course (SEC-II)
Unit 1: Data Analysis and data representation of Physiological data- Bar Diagram, Pie Diagram, Computation of Data- Mean, Median and Mode.
Unit 2:Basic Application of Computer in Physiological data Analysis – M.S. Word and M.S. Excel.

Semester V

DSE 1A [4 credits]
Nutrition & Dietetics:
Basic constitution of food & their nutritional significance. Vitamins: deficiency symptoms & daily requirements, hypervitaminosis. Mineral metabolism: Ca, Fe, P. BMR: definition, factors affecting, determination by Benedict Roth apparatus. RQ: definition, factors affecting, significance. Biological value of proteins, essential & non essential amino acids, N2 equilibrium, minimum protein requirement. Positive and negative N_2 balance. SDA - definition & importance. Food groups, Balanced diet and principles of formulation of balanced diets for growing child, adult man and woman, pregnant woman and lactating woman. Nitrogen balance, essential amino acids, biological value of proteins – measurement and factors affecting. Proteins sparers. Supplementary value of protein. Dietary fibres. Principle of diet survey. Composition and nutritional value of common food stuffs. Physiology of starvation and obesity
[4 Credits] (40 lectures)

DSE 1A lab [2 credits]
Diet Survey Report:
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.

DSE 2A [4 credits]
Work Physiology and Ergonomics
Physical work—its definition and nature—isotonic, isometric and isokinetic, positive and negative work. Concept of physiological work. Power and capacity relation. Work -load – light, moderate(submaximal) and heavy (maximal) depending on intensity and duration of work. Exercise inducing equipment – bicycle ergometer, treadmill and stepping stool. Energetics of work – sources of energy and energy demand for different activities. Assessment of energy cost of various physical work – direct and indirect methods with their limitations. Physiological responses to work – cardiovascular, respiratory, metabolic and muscular – short- term and long-term. Work-rest cycle and importance of rest pause. Ergogenic aids. Basic concept of

ergonomics and its application in industry to improve efficiency and industrial safety as well as to restrict occupational health hazards. Anthropometry and its implication in ergonomics in general
[4 Credits] (40 lectures)

DSE 2A lab [2 credits]

a) Measurement of some common anthropometric parameters : stature, weight, eye height, shoulder height, elbow height. sitting height, elbow rest height (sitting), knee height (sitting), arm reach from wall, mid-arm circumference, waist circumference, hip circumference, neck circumference,head circumference, chest circumference.
b) Calculation of Body Surface Area (using a nomogram) and Body Mass Index (BMI) from nthropometric measurements.
c) Determination of Physical Fitness Index (PFI) of an individual by modified Harvard step test and recording of recovery heart-rate after standard exercise.

DSE 3A [4 credits]

Nervous System

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

DSE 3A lab [2 credits]

1. Measurement of visual acuity
2. Test on Stretch reflex
3. Measurement of reaction time by ruler drop test
4. Test of motor learning

SEC

SEC- 3: Community Health

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

Semester VI

DSE 1b [4 credits]

Microbiology, immunology and molecular biology

Virus - DNA virus and RNA virus. Bacteriophage. Bacteria-structure and morphological classification. Gram positive and Gram negative and acid-fast bacteria. Pathogenic and nonpathogenic bacteria - definition with a few examples. Sterilization and Pasteurization. A brief idea of antibiotics. Elementary knowledge of innate and acquired immunity. Humoral and cell mediated immunity Vaccination - principles and importance of immunization. Basic principle of immunological detection of pregnancy. Purine and pyrimidine bases, nucleosides, nucleotides and polynucleotides. Basic structure of different types DNA and RNA. Elementary idea of gene, genome, transcription, genetic code, translation and genetic engineering

[4 Credits] (40 lectures)

DSE 1b lab[2 credits]

Microbiology

Gram staining of bacteria and identification of Gram positive and Gram negative bacteria.

DSE 2b [4 credits]

Hematology and thermoregulation

a) Blood groups - ABO and Rh. Blood transfusion - precaution and hazards. Immunological basis of identification of ABO and Rh blood groups. Functions and estimation of haemoglobin. Abnormal haemoglobins - thalassaemia and sickle-cell anaemia. Definition, determination and significance of TC, DC, ESR, Arneth count, PCV, MCV, MHC, MCHC, bleeding time, clotting time and prothrombin time. Anaemia- types (definition and causes). Leucocytosis, leucopenia and leukaemia. Purpura. Pathophysiological significance of the following blood constituents: glucose, urea, creatinine, uric acid, cholesterol, bilirubin, SGPT and SGOT, alkaline and acid phosphatases and ketone bodies.

b) Channels of heat regulation – skin , lung and others organs. Structure and functions of skin. Sweat glands – structure and composition of sweat. Sweat formation, secretion and its regulation. Insensible perspiration. Regulation of body temperature in homeotherms – its physical and physiological processes, roles of neural
and hormonal processes. Pyrexia, hyperthermia

[4 Credits] (40 lectures)

DSE 2b lab[2 credits]

1. Differential count of WBC
2. Determination of clotting time , bleeding time
3. Determination of blood group
4. Determination of ESR

Optional DSE course sixth Semester

Environmental Physiology

Ecosystem – structure and function, different types of ecosystem, food chains, food webs and energy flow and mineral cycling in ecosystems; primary production and decomposition , Biogeochemical cycle. Global environmental problems: global climate change ,ozone layer depletion, the green house effect, global warming and its consequences. Environment – Physical and biological aspects. Effects of exposure to hot and cold environment. Acclimatization to hot and cold environment. Heat disorders and its preventive measures. Effects of hypobaric and hyperbaric environment. Caisson disease. Preventive

measure for hypobaric and hyperbaric effects. Acclimatization to high altitudes. G force, ionizing and non-ionizing radiations - physiological effects and preventive measures.
Air, noise and water pollutions – causes, effects, prevention measures and control. Brief idea of the hazards of pesticides, carcinogens, mutagens, neurotoxins and war gases. Impact of green house effects on life Radio-active wastes and their health effects.
[4 Credits] (40 lectures)

DSE 3A lab [2 credits]

i)Measurement of environmental temperature - dry bulb and wet bulb, relative humidity,
ii)Determination of O_2, CO_2, Determination of total alkalinity, and chlorine in water by titration method,
ii) Measurement of noise

SEC

SEC- 4: Clinical Biochemistry

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