



UNIVERSITY OF CALCUTTA

GURUPADA SAREN

SECRETARY

COUNCILS FOR UNDERGRADUATE STUDIES,
UNIVERSITY OF CALCUTTA.

Ref.No : CUS/ 101 (Cir.) /18
Dated the 05th March, 2018

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To
The Principals/T.I.C.
of all the Undergraduate Colleges
offering B.Sc. (Honours & General) in Physiology
affiliated to the University of Calcutta

Sir/Madam,

The undersigned is to inform you that the proposed semester wise **draft syllabus for Physiology (General) and corrected version of semester wise draft Syllabus for Physiology (Honours) Courses of Studies under CBCS has been uploaded in the Calcutta University website (www.caluniv.ac.in).**

The said syllabus has been prepared by the **U.G. Board of Studies in Physiology, C.U.**

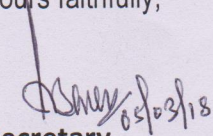
You are requested kindly to go through it and send your feedback within 20th March, 2018.

In this regard you may send your observation/ suggestion to the **Department of U.G. Councils, C.U.** or through email (u.g.councilsc.u@gmail.com), and you also may contact **Prof. Debasish Bandyopadhyay, Department of Physiology** through e-mail (debasish63@gmail.com).

Your cooperation in this regard will be highly appreciated. Kindly treat the matter as urgent.

Thanking you,

Yours faithfully,


Secretary

University of Calcutta
PHYSIOLOGY (GENERAL) SYLLABUS FOR CBCS
DRAFT SYLLABUS

Core Courses

1. Cellular Basis of Physiology
2. Biophysical Principles, Enzymes and Chemistry of Bio-molecules
3. Blood and Body Fluids
4. Cardiovascular System
5. Respiratory System
6. Digestion and Absorption
7. Metabolism
8. Nutrition and Dietetics
9. Nerve-muscle Physiology
10. Nervous System
11. Special Senses
12. Endocrinology
13. Reproductive Function
14. Excretory Physiology

Discipline Specific Electives (DSE)(Any Four)

1. Biostatistics
2. Microbiology
3. Immunology
4. Work Physiology and Ergonomics
5. Exercise and Sports Physiology
6. Human Nutrition and Dietetics
7. Genetics and Molecular Biology
8. Environmental Pollutions and Human Health Hazards

Generic Elective (GE)(Any Four)

1. Developmental Biology/ Embryology
2. Instrumentation
3. Environmental Pollution and Human Health
4. Biotechnology
5. Haematology
6. Community and Public Health

Ability Enhancement Course (AEC) (Compulsory)

1. Environmental Science
2. English/MIL Communication

Skill Enhancement Course (SEC) (Any two)

1. Detection of Food Additives /Adulterants
2. Histopathological Techniques
3. Clinical Biochemistry
4. Hematological Techniques
5. Pathological Microbiology/Bio-Medical Technology
6. Diet Survey and formulation of Diet Chart

Outline of Courses and Credits in Each Semester

Semester I

(A) Core Courses (CC). Theoretical (T)

CC1T. Cellular Basis of Physiology

Structure and functions of plasma membrane, nucleus and different cell organelles – Endoplasmic reticulum, Golgi bodies, Mitochondria, Lysosome and Peroxisome. Structure, function and classification of Epithelial, Connective, Muscular and Nervous tissues. (4)

CC2T. Biophysical Principles, Enzymes and Chemistry of Bio-molecules

Physiological importance of the following physical processes: Diffusion, Osmosis and Surface tension. pH and Buffers – Significance in human body and maintenance of pH in the blood. Colloids - Classification and physiological importance.

Enzymes: Classification, factors affecting enzyme action. Concept of coenzymes and isozymes.

Carbohydrates : Definition and classification.

Monosaccharides – Classification, structure, physiological importance.

Disaccharides – Maltose, Lactose and Sucrose: Structure, occurrence and physiological importance.

Polysaccharides – Starch, Glycogen, Dextrin, Cellulose.

Lipids : Definition and classification. Fatty acids – Classification.

Properties of Fat and Fatty acids—Hydrolysis, Saponification number, Iodine number, Rancidity-Acid number. Phospholipids, Cholesterol & its ester – physiological importance.

Amino acids, Peptides and Proteins: Classification and structure.

Structure of peptide bonds.(4)

Practical (P)

Semester II

(A) Core Courses (CC). Theoretical (T)

CC3T. Blood and Body Fluids

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. (4)

CC4T. Cardiovascular System

Anatomy and histology of the heart. Properties of cardiac muscle. Origin and propagation of cardiac impulse. Cardiac cycle : Events. Heart sounds. Heart rate. Cardiac output: Determination by following Fick principle, factors affecting, regulation.

Structure of arteries, arterioles, capillaries, venules and veins. Pulse - arterial and venous. Blood pressure and its regulation and factors controlling. Baro- and chemoreceptors. Vasomotor reflexes. Measurement of blood pressure. Peculiarities of regional circulations: coronary and cerebral. (4)

Practical (P)

Semester III

(A)Core Courses (CC). Theoretical (T)

CC5T. Respiratory System

Anatomy and histology of the respiratory passage and organs. Role of respiratory muscles in breathing. Lung volumes and capacities. Exchange of respiratory gases between lung and blood and between blood and tissues. Transport of oxygen and carbon dioxide in blood. Regulation of respiration - neural and chemical. Hypoxia. (4)

CC6T. Digestion and Absorption

Structure in relation to functions of alimentary canal and digestive glands. Composition, functions and regulation of secretion of digestive juices including bile. Digestion and absorption of carbohydrate, protein and lipid. Movements of the stomach and small intestine. (4)

CC7T. Metabolism

Glycolysis, TCA cycle, Glycogenesis, Glycogenolysis. Gluconeogenesis. Beta oxidation of saturated fatty acid. Ketone bodies – metabolism . Deamination, Transamination. Amino acid pool - functions of amino acids in the body. Formation of urea and its importance. (4)

Practical (P)

Semester IV

(A)Core Courses (CC). Theoretical (T)

CC8T. Nutrition and Dietetics

Basic constituents of food and their nutritional significance. Vitamins classification, functions, deficiency symptoms and daily requirements. Hypervitaminosis. Mineral metabolism - Ca, P, Fe. BMR: definition, factors affecting. Respiratory quotient: definition, factors affecting and significance.

Biological value of proteins. Essential and non-essential amino acids. Nitrogen balance. SDA : definition and importance. (4)

CC9T. Nerve-muscle Physiology

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

Different types of muscle and their structure. Red and white muscle. Muscular contraction: structural, mechanical and chemical changes in skeletal muscle during contraction and relaxation. Isotonic and isometric contractions. Properties of muscle: all or none law, beneficial effect, summation, refractory period, tetanus, fatigue. A brief idea about the muscle spindle. (4)

CC10T. Nervous System

A brief outline of organization and basic functions (sensory, motor and association) of the nervous system, central and peripheral nervous system. Ascending tracts carrying touch, kinaesthetic, temperature and pain sensations. Descending tracts: pyramidal tract and brief outline of the extra-pyramidal tracts. Reflex action - definition, reflex arc, classification, properties. Functions of the spinal cord. Outline of functions of brain stem.

A brief idea of the structure, connections and functions of cerebellum. Different nuclei and functions of thalamus and hypothalamus. Cerebral cortex: histological structure and localization of functions. CSF : composition, formation, circulation and functions. A brief description of the organization of the autonomic (sympathetic and parasympathetic) nervous system. Functions of sympathetic and parasympathetic nervous system. A brief idea of speech, aphasia, conditioning, learning and memory.

(4)

Practical (P)

Semester V

(A)Core Courses (CC). Theoretical (T)

CC11T. Special Senses

Classification of general and special senses and their receptors. Receptors as biological transducer.

- (a) *Olfaction and Gustation*: Structure of sensory organ, neural pathway of olfactory and gustatory sensation. Physiology of olfactory and gustatory sensation. Olfactory and gustatory adaptation. After-taste.
- (b) *Audition*: Structure of ear, auditory pathway, mechanism of hearing.
- (c) *Vision*: Structure of the eye. Histology of retina. Visual pathway. Light reflex. Chemical changes in retina on exposure to light. Accommodation - mechanism and pathway. Errors of refraction. Positive and negative after-

image. Light and dark adaptation. Elementary idea of colour vision and colour blindness. (4)

CC12T. Endocrinology

Anatomy of endocrine system. Hormones - classification. Elementary idea of mechanism of hormone action.

Hypothalamus: Basic concept of neurohormone.

Hypothalamo-hypophyseal tract and portal system.

Pituitary: Histological structure, hormones, functions. Hypo and hyper active states of pituitary gland.

Thyroid: Histological structure. Functions of thyroid hormones (T_4T_3).

Thyrocalcitonin. Hypo and hyper-active states of thyroid.

Parathyroid: Histological structure, functions of parathyroid hormone. Tetany.

Adrenal Cortex: Histological structure and functions of different hormones. Hypo and hyper-active states of adrenal cortex.

Adrenal Medulla: Histological structure and functions of medullary hormones. The relation of adrenal medulla with the sympathetic nervous system.

Pancreas: Histology of islets of Langerhans. Origin and functions of pancreatic hormones. Diabetes mellitus.

Brief idea of the origin and functions of renin-angiotensin, prostaglandins, erythropoietin and melatonin. Elementary idea of gastrointestinal hormone.

(4)

Practical (P)

Semester VI

(A)Core Courses (CC). Theoretical (T)

CC13T. Reproductive Physiology

Primary and accessory sex organs and secondary sex characters.

Testis: histology, spermatogenesis, testicular hormones and their functions.

Ovary: histology, oogenesis, ovarian hormones and their functions.

Menstrual cycle and its hormonal control.

Maintenance of pregnancy – role of hormones. Development of mammary gland and lactation - role of hormones. (4)

CC14T. Excretory Physiology

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

Structure and functions of skin. Insensible and sensible perspiration Regulation of body temperature — physical and physiological processes involved in it. Physiology of sweat secretion and its regulation.
(4)

Practical (P)

Credit Distribution Across Courses

COURSE TYPE	TOTAL PAPERS	CREDITS
		THEORY+ PRACTICAL
Core Courses	14	14X4=56 14X2=28
Discipline Specific Electives	4	4X4=16 4X2=8
Generic Electives	4	4X4=16 4X2=8
Ability Enhancement Language Courses	2	2X2=4
Skill Enhancement Courses	2	2X2=4
TOTALS	26	140

Practicals for core courses:

CC1P:

- 1.Examination and staining of fresh tissues : Squamous and ciliated epithelium by Methylene Blue stain.
2. Qualitative tests for identification of : Glucose, Fructose, Lactose, Sucrose, Starch, Dextrin, Lactic acid and Hydrochloric acid.

CC2P

1. Examination and staining of fresh tissues : Cornified and Columnar Epithelium.
2. Qualitative tests for identification of : Albumin, Gelatin, Peptone, Urea, Acetone, Glycerol and Bile Salts.

- CC3P:**
- 1.Preparation and staining of human blood film with Leishman stain and identification of different types of blood cells.
 - 2.Preparation of hemin crystals.

CC4P:

- 1.Demonstration- kymographic recording of the unperfused heart of toad and effects of warm and cold saline.
2. Measurement of systolic and diastolic pressure by sphygmomanometer and determination of pulse and mean pressure.

- CC5P:**
- 1.Measurement of peak expiratory flow rate.
 - 2.Pneumographic recording of respiratory movements.

- CC6P:** _Study and Identification of Stained Sections of Different Mammalian Tissues and Organs:
Salivary Glands, Esophagus, Stomach, Small Intestine, Large Intestine, Tongue, Liver, Lung and Trachea.

- CC7P:**
- 1.Quantative estimation of glucose by Benedict's method (percentage).
 - 2.Quantitative estimation of amino nitrogen (Sorensen's formol titration method [percentage as well as total quantity to be done]).

CC8P: Diet survey report (hand-written) of a family (as per ICMR specification): Each student has to submit a report on his/her own family.

CC9P: 1. Silver Nitrate preparation of Node of Ranvier.
2. Examination and staining of skeletal and cardiac muscles by Methylene Blue stain.

CC10P: 1. Demonstration : Use of kymograph, induction coil and mercury key. Recording of simple muscle curve with sciatic-gastrocnemius muscle preparation of toad.
2. Effects of load and summation of stimuli.

CC11P:

Determination of visual acuity by Snellen's chart / Landolt's C chart.

Determination of colour blindness by Ishihara chart.

Exploration of conductive and perceptive deafness by tuning fork method.

CC12P: Study and Identification of Stained Sections of Different Mammalian Tissues and Organs:

Thyroid Gland, Adrenal Gland, Pancreas, Spleen, Lymph Gland & other practicals to be included.

CC13P:

Study and Identification of Stained Sections of Different Mammalian Tissues and Organs:

Testes, Ovary, Kidney, Ureter, Skin, Spinal cord, Cerebral cortex, Cerebellum & other practicals to be included

CC14P. Identification of normal and abnormal constituents of urine.

Discipline Specific Electives (DSE)(Any Four)

Biological Statistics (DSE1T)

Biostatistics

Basic concepts– Variable, population, parameter, sample, statistic. Classification of data – qualitative and quantitative, continuous and discontinuous.

Presentation of data–frequency distribution, bar diagram, pie diagram, frequency polygon and histogram.

Mean, median, mode, standard deviation and standard error.

Biological statistics practical (DSE 1P)

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.

Microbiology (DSE 2T)

Microbiology

Virus - DNA virus and RNA virus. Bacteriophage.

Bacteria-structure and morphological classification. Gram positive and Gram negative and acid-fast bacteria. Pathogenic and non-pathogenic

bacteria - definition with a few examples. Sterilization and Pasteurization.

Bacterial growth curve.

Elementary idea of bacteriostatic and bacteriocidal agents.

Microbiology Practical (DSE 2P)

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

Immunology (DSE 3T)

Elementary knowledge of innate and acquired immunity. Humoral and cell mediated immunity. Vaccination – Principles, types and importance of immunization. Basic principle of immunological detection of pregnancy.

Immunology (DSE 3P)

Agglutination test: Blood group determination

Immunoprecipitation test

Work Physiology and Ergonomics (DSE 4T)

Ergonomics. Importance of ergonomics in occupational health and well being. Classification of Physiological work load. Concept of work rest cycle. Physical work environment :

- (a) Thermal environment, its' effect, Heat stress indices,
- (b) Noise and vibration, its' effect on workers.

Anthropometry and its uses.

Work Physiology and Ergonomics (DSE 4P)

1. Measurement of working heart rate by ten beats methods.
2. Measurement of blood pressure before and after different grades of exercise.
3. Measurement of some common anthropometric parameters. Calculation of BSA and BMI from anthropometric data.

Exercise and Sports Physiology (DSE 5T)

Energy sources during exercise (ATP-CP System, Anaerobic system and Aerobic system).

Cardio-respiratory responses during different grades of exercise.

Concept of excess post exercise oxygen consumption (EPOC), physiological fatigue and recovery.

Aerobic work Capacity: Measurement, physiological factors and applications. Physical fitness and its assessment by modified Harvard Step Test.

Exercise and Sports Physiology (DSE 5P):

- (a) Measurement of blood pressure before and after different grades of exercise.
- (b) Recording of recovery heart-rate after standard exercise.
- (c) Determination of Physical Fitness Index by modified Harvard Step Test.
- (d) Measurement of body fat percentage.

Human nutrition and dietetics (DSE 6T):

Basic concept of energy and units. Fuel value of foods. Body calorie requirements – adult consumption unit. Dietary requirements of carbohydrate, protein, lipid and other nutrients. Supplementary value of protein. Dietary fibres. Principles of diet survey. Composition and nutritional value of common food stuffs.

Nutrition and Dietetics - Diet Survey (Field Study Record) (DSE 6P): Diet survey report (hand-written) of a family (as per ICMR specification) : Each student has to submit a report on his/her own family.

Genetics and Molecular Biology(DSE 7T)

Genetics: Basic principles of Mendelian genetics.

Human Cytogenetics - Human karyotype. Inborn errors of metabolism.

Sex determination and sex linkage.

Molecular Biology: Genes - definition. DNA- structure, DNA replication, transcription of RNA in prokaryotes, translation in prokaryotes. Genetic Code.

Genetics and Molecular Biology (DSE 7P): To be set in the workshop

Environmental Pollutions and Human Health Hazards (DSE 8T)

Definition: hygiene, health and public health.

Air, Water, Food Borne Diseases: causes, symptoms and control.

Food Additives and Adulterants: definition, examples and human health hazards.

Air Pollution: definition, sources, air pollutants, effects of air pollution on human health, concept of ozone hole, green house effects and global warming.

Water Pollution: definition, types, health hazards, water pollutants, biochemical oxygen demand (BOD), thermal pollution, concept of safe drinking water standards.

Sound Pollution: definition, concept of noise, source of sound pollution, effects of sound pollution on human health, noise

index (noise standards).

Environmental Pollutions and Human Health Hazards (DSE 8P)

Determination of BOD & COD in water from different sources

Generic Elective (GE)(Any Four)

Developmental Biology (GE 1T): Ultra structure: sperm and ovum in human. Egg Membranes, Fertilization, Blastulation, Gastrulation, Implantation in mammals. Development of heart.

Developmental Biology (GE 1P): H & E staining of ovarian tissue sections and identification of Graafian follicle, Corpus Luteum.

Instrumentation (GE 2T):

Compound Microscopy, Spectrophotometry and Spectrofluorometry. Principles and uses of paper and thin layer chromatography. Electrophoresis. Ultracentrifugation.

Instrumentation (GE 2P):

Handling of compound microscope. Estimation of serum protein by Biuret Method. Estimation of Albumin using Bromocresol Green.

Environmental pollution and human health (GE 3T):

Air Pollution: definition, sources, air pollutants, effects of air pollution on human health, concept of ozone hole, green house effects and global warming.

Water Pollution: definition, types, health hazards, water pollutants, biochemical oxygen demand (BOD), thermal pollution, concept of safe drinking water standards.

Soil Pollution: causes, health hazards, solid waste managements- bioremediation, phytoremediation.

Sound Pollution: definition, concept of noise, source of sound pollution, effects of sound pollution on human health, noise index (noise standards).

Environmental pollution and human health (GE 3P):

1. Determination of BOD and COD.
2. Determination of sound intensities at different work places.

Biotechnology (GE 4T): Definition, history of biotechnology, importance of biotechnology. Cloning, Gene therapy, Transgenic animals, Hybridoma Technology.

Biotechnology (GE 4P): To be set in the workshop.

Haematology (GE 5T): 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, Arneht count, PCV, MCV, MHC, MCHC, bleeding time, clotting time and prothrombin time. Anaemia - types (definition and causes). Leucocytosis, leucopenia and leukaemia. Purpura.

Haematology (GE 5P): DC of WBC, estimation of haemoglobin, blood group determination, bleeding time and coagulation time.

Community and Public Health (GE 6T): Basic idea about community health and public health issues, Malnutrition in a community, overnutrition, issues of obesity; possible remedial measures. Basic idea on PCM, marasmus, kwashiorkor and their prevention. Iron and iodine deficiency. Arsenic in ground water.

Sound pollution as a community health issue; definition, concept of noise.

Community and Public Health (GE 6P): Formulation of diet chart of growing children, pregnant & lactating women and Diabetic patients.

Ability Enhancement Course (AEC) (Compulsory)

1. Environmental Science
2. English/MIL Communication

Environmental Science (AEC 1T):

English / MIL Communication (AEC 2T):

Skill Enhancement Course (SEC) (Any two)

1. Detection of Food Additives /Adulterants
2. Histopathological Techniques
3. Clinical Biochemistry
4. Hematological Techniques
5. Pathological Microbiology/Bio-Medical Technology
6. Diet Survey

Detection of Food Additives / Adulterants (SEC 1):

Qualitative tests for identifying Food Adulterants in some food samples: Metanil yellow, Saccharin, Aluminium foil, Margarine, Dioxin etc in turmeric powder.

Histopathological Techniques (SEC 2):

Preparation of tissue sections, H&E staining of tissue sections.

Clinical Biochemistry (SEC 3):

Photo-colorimetric estimation of blood constituents. Measurement of serum total protein by Biuret method and determination albumin globulin ratio.

Hematological Techniques (SEC 4):

Preparation of blood smear and identification of blood cells. Determination of bleeding time, clotting time etc. Measurement of haemoglobin in blood.

Pathological Microbiology / Bio-Medical Technology (SEC 5):

Staining of gram positive and gram negative bacteria. Demonstration of an ECG machine at work. Handling of Doctor's centrifuge. Handling of colorimeter / spectrophotometer.

Diet survey and formulation of diet chart (SEC 6):

Survey of dietary status of people in the nearby area by the students, analysis of survey results, and, formulation of diet chart.

UNIVERSITY OF CALCUTTA
PHYSIOLOGY (HONS.) SYLLABUS FOR CBCS
REVISED DRAFT

Core Courses

1. Cellular Basis of Physiology
2. Biophysical Principles & Enzymes and Chemistry of Biomolecules
3. Nerve-muscle Physiology
4. Nervous System
5. Blood and Body Fluids
6. Cardiovascular System
7. Respiratory System
8. Digestion and Absorption
9. Metabolism
10. Nutrition and Dietetics
11. Special Senses
12. Endocrinology
13. Reproductive Physiology
14. Excretory Physiology

Outline of Courses and Credits in Each Semester

Core Courses

1. Cellular Basis of Physiology & Enzymes
2. Biophysical Principles and Chemistry of Biomolecules
3. Nerve-muscle Physiology
4. Nervous System
5. Blood and Body Fluids
6. Cardiovascular System
7. Respiratory System
8. Digestion and Absorption
9. Metabolism
10. Nutrition and Dietetics
11. Special Senses
12. Endocrinology
13. Reproductive Physiology
14. Excretory Physiology

Core Courses (CC). Theoretical (T)

Semester I

CC1T.

- **Cell Structure and function**--Electron microscopic structure and functions of nucleus (chromosome structure and its packaging), nucleosome, endoplasmic reticulum, ribosomes, Golgi bodies, mitochondria, lysosomes, peroxisomes cytoskeletal elements, centrosomes and plasma membrane and sub-cellular membranes.
- **Cellular transport**—Passive and active transport. Ion channels, ionophores.
- **Intercellular communication**--- Basic idea of tight junctions, gap junctions, adherens junctions and desmosomes.
- **Cell cycle** – Events and regulatory role of cyclin. Cell division- Mitosis & Meiosis- phases and significance.
- **Enzymes** : Classification-EC nomenclature, Concept of apoenzyme, holoenzyme, coenzyme, cofactors and prosthetic group. Mechanism of

enzyme action. 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: K- and M- series. Feed-back inhibition. Rate-limiting enzymes. Isozymes, Ribozymes and Abzymes. (4)

CC2T.

- **Diffusion** : Its characteristics, factors influencing and physiological applications.
- **Osmosis**: Osmotic pressure – laws, determination – freezing point depression method and physiological applications.
- **Surface tension & viscosity**-- Physiological applications.
- **pH & Buffer**- Henderson Hasselbach- equation (quantitative problems). Determination of pH.
- **Colloids** : Classification, properties – optical, electrical, electrokinetic. Physiological importance of colloids.
- **Gibbs-Donnan membrane equilibrium**.
- **Thermodynamics** : Type of surroundings and systems. First Law– Internal energy, enthalpy. Second Law – Entropy, Free energy change, Endergonic and Exergonic reactions, Reversible and Irreversible processes, Equilibrium constant. Physiological steady-state, Living body as a thermodynamic system.
- **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 : Structure, Occurrence and Physiological importance. *Polysaccharides* – Starch, Glycogen, Dextrin, Cellulose, Glycosaminoglycans, Glycoproteins, Sialic acids.
- **Lipids** : Definition and classification. Fatty acids – Classification, systemic nomenclature and structure. Mono-, Di- and Triglycerides. Properties of Fat and Fatty acids ---Hydrolysis, Saponification number, Iodine number, Acetyl number, Acid number, Reichert-Meissl number. Cis-trans isomerism.

Eicosanoids, Phospholipids, Glycolipids, Sphingolipids, Cholesterol & its ester --- their structure and physiological importance. Lipoproteins - Structure and classification.

- **Amino acids** : Classification, Structure, Nomenclature and Optical properties. Protonic equilibria of amino acids – Zwitterions, Isoelectric point, titration curve of amino acids. Reactions with ninhydrin and formaldehyde.
- **Peptides and Proteins** : Structure and properties of peptide bonds -- Phi and Psi angles. Reactions with Sanger's and Edman's reagent. Biuret reaction. Different levels of protein structure -- Primary, Secondary (α -helix and β -pleated sheet), Tertiary and 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 C_{0t} value. **(4)**

CC1P. Qualitative tests for the identification of physiologically important substances: Hydrochloric acid, Lactic Acid, Uric Acid, Albumin, Gelatin, Peptone, Starch, Dextrin, Glucose, Fructose, Lactose, Sucrose, Urea, Acetone, Glycerol and Bile salts.**(2)**

CC2P. Study of various stages of meiosis from grasshopper testis **Or**
Cell viability study by Trypan blue staining **(2)**

Semester II

CC3T.

- **Nerve** : Structure, classification and functions of neurons and neuroglia. 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. Synapses : types, structure, synaptic transmission of the impulse. The neuromuscular junction : structure, transmission of nerve impulse across the NMJ to the muscle. Motor unit. Motor point. Degeneration and regeneration in peripheral nerve fibre. Nerve growth factors.

➤ **Muscle:** Electron microscopic structure of skeletal, smooth and cardiac muscles. The sarcotubular system. Red and white striated muscle fibers. Single-unit and multi-unit smooth muscle. Properties of skeletal muscle: excitability, contractility, all or none law, summation of stimuli, summation of contractions, effects of repeated stimuli, genesis of tetanus, onset of fatigue, refractory period, conductivity and elasticity. Mechanism of skeletal and smooth muscle contraction and relaxation. Isometric and isotonic contractions. Mechanical, chemical, and thermal changes in skeletal muscle during contraction and relaxation. **(4)**

CC4T.

The Nervous System

- Structural organization of different parts of brain and spinal cord. Reflex action – definition, reflex arc, classification and properties.
- **Autonomic nervous system** : organization, outflow, ganglia, centers and functions. Chemical transmission in autonomic nervous systems.
- **CSF:** Formation, circulation and functions. Blood-CSF and Blood-Brain barrier.
- **Ascending and descending tracts** : origin, courses, termination and functions.
- **Functions of the spinal cord** with special reference to functional changes following hemisection and complete section of spinal cord. Pain production, perception and regulation. Referred pain.
- **Muscle spindle and golgi tendon organ:** their structure, innervations and functions, postural reflexes. Decorticate, decerebrate rigidity and spinal animal.
- **Brain:** Structure, nerve connections and functions of brainstem, cerebellum, reticular formation, hypothalamus, thalamus, basal nuclei and cerebral cortex. Structure and functions of vestibular apparatus.
- **Limbic system:** Structure, connections and functions.
- Physiology of sleep, memory, learning and speech. **(4)**

CC3P. Histological Study of Nerve and Muscle.

Staining of isolated nerve fiber by silver nitrate method.

Staining of skeletal & cardiac muscle by methylene blue. **(2)**

CC4P. Basic concepts of brain imaging. Identification of different structures of human brain using CT scan and MRI images.

Study and use of Kymograph, induction coil, key, Gastrocnemius-sciatic preparation and kymographic recording of isotonic muscle twitch .
Interpretation of effects of temperature, two successive stimuli and load (after-load) on muscle twitch. **(2)**

Semester III

CC5T.

Physiology of Blood and Body Fluids

- **Bone marrow:** Formed elements of blood—origin, formation, functions and fate.
- **Plasma proteins :** Synthesis and functions.
- **Haemoglobin :**Structure, reactions, biosynthesis and catabolism. Foetal haemoglobin. Abnormal haemoglobins- Sickle-cell anemia and Thalassemia.
- **Blood volume :** Regulation and determination by dye and radioisotope methods.
- **Hemostasis :** Factors, mechanism, anticoagulants, procoagulants. Disorders of hemostasis- Hemophilia, Thrombosis and Embolism.
- **Blood group :** ABO and Rh. Erythroblastosis foetalis. Blood transfusion and its hazards.
- **Lymph and tissue fluids :** Formation, circulation, functions and fate.
- **Lymphatic organs :** Histological structures and functions of lymph gland and spleen.
- **Regional circulations :** Cerebral circulation & stroke. Coronary Circulation.

(4)

CC6T. Cardiovascular System

- Anatomy of the heart. Properties of cardiac muscle. Origin and propagation of cardiac impulse. Heart Block.
- **Cardiac cycle :** Pressure and volume changes. Heart sounds. Murmurs.
- **Cardiac output :** Measurement by application of Fick's principle & factors affecting.
- Starling's law of heart.

- **Electrocardiography:** The normal electrocardiogram, electrocardiographic leads, vectorial analysis, the vectorcardiogram and the mean electrical axis of heart. The His bundle electrogram.
- Principles of Echocardiography.
- Cardiac Arrhythmias & Myocardial Infarctions.
- **The pulse :** Arterial and venous.
- Hemodynamics of blood flow.
- Cardiac and vasomotor centers, baroreceptors and chemoreceptors, innervation of the heart and blood vessels, cardiac and vasomotor reflexes. Cardiovascular homeostasis – neural and chemical control of cardiac functions and blood vessels.
- **Blood pressure :** Its measurement and factors affecting.
- Cardiovascular adjustment after haemorrhage. **(4)**

CC7T. Respiratory System

- **Anatomy and histology** of the lung and airways.
- **Mechanics of breathing :** role of respiratory muscles, glottis. Compliance of lungs and chest wall, pressure-volume relationships, alveolar surface tension and surfactant, work of breathing.
- **Spirometry:** Lung volumes and capacities. Dead space.
- **Pulmonary Circulation :** Ventilation- perfusion ratio.
- **Transport of gases in body :** Partial pressure and composition of normal atmospheric gases in inspired, expired, alveolar airs and blood. Oxygen dissociation curve of hemoglobin and myoglobin – factors affecting. Carbon dioxide dissociation curve. Regulation of respiration – neural and chemical, respiratory centers, chemoreceptors, baroreceptors, pulmonary receptors.
- **Disorders of Breathing :** Hypoxia : Types, effects. Asphyxia, Voluntary hyperpnoea, Apnoea, Cyanosis, Periodic breathing, Asthma, Emphysema.
- Concept of non-respiratory functions of lung. **(4)**

CC5P.

- **Haematological experiments :** Preparation and staining of blood film with Leishman's stain. Identification of blood cells. Total count of W.B.C and R.B.C .Differential count of W.B.C. Haemoglobin estimation by Sahli's

hemoglobinometer/ colorimetric method. Preparation of haemin crystals. Preparation and staining of bone marrow. Measurement of diameter of megakaryocytes. Reticulocyte staining. (2)

CC6P.

- **Cardiovascular Physiology Experiments** : Determination of Blood pressure by Auscultatory Method. Determination of mean and pulse pressures and pulse rate. Preparation of Amphibian Ringer Solution. Interpretation of Kymographic recording of the movements of perfused heart of toad and the effects of changes in perfusion pressure, changes in temperature, excess calcium and potassium ion concentration, acetylcholine ,adrenaline on the contraction of heart. (2)

CC7P.

- **Respiratory Human Experiments:** Measurement of peak expiratory flow rate. Analysis of Spirometric recordings. Pneumographic recording of effects of talking, drinking, laughing, coughing, exercise, hyperventilation and breath holding. (2)

Semester IV

CC8T. Digestion and Absorption

- 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. Enterohepatic circulation.
- Digestion and absorption of carbohydrates, lipids, proteins and nucleic acids.
- Defecation. GALT. Basic concepts of Peptic Ulcer, Jaundice and Gall-stones. (4)

CC9T. Metabolism

- Redox potential. Mitochondrial Electron Transport Chain. Oxidative phosphorylation- inhibitors and uncouplers.
- **Carbohydrate** : Glycolysis, R-L cycle. TCA cycle, Gluconeogenesis - Cori 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 required.

- **Amino acids:** Amino acids - Amino acid pool. Deamination, transamination, amination and decarboxylation. Synthesis of Urea and Nitric oxide. Glucogenic and ketogenic amino acids. Metabolism of glycine, methionine, tryptophan and phenylalanine.
- **Purines and Pyrimidines** – Biosynthesis : *de novo* and salvage pathways. Catabolism.

Regulation of the above mentioned biochemical pathways/cycle not required.

- **Lipid Metabolism :** β -oxidation and biosynthesis of saturated and monounsaturated fatty acids. Biosynthesis of lecithin. Biosynthesis of Cholesterol. Ketone body metabolism.

Hormonal regulation of the above mentioned biochemical pathways not required.

- **Reactive Oxygen Species and antioxidants :** Formation of Reactive Oxygen Species and the role of Catalase, Superoxide Dismutase, Glutathione Peroxidase and Glutathione Reductase in combating oxidative stress – role of vitamins, role of melatonin as an antioxidant **(4)**

CC10T. Nutrition and dietetics

- **Vitamins:** Thiamin, Riboflavin, Niacin, Pyridoxine, Pantothenic Acid, Biotin, Cyanocobalamin, Folic Acid, Ascorbic Acid, Inositol. Vitamins A, D, E and K. Dietary sources, daily requirements, biochemical functions, deficiency symptoms, hypervitaminosis, antivitamins.
- **Minerals:** Sources, biological functions of sodium, potassium, calcium, phosphorus, iron, zinc, iodine and fluoride.
- **SDA, RQ and BMR :** Factors affecting. Determination of BMR.
- Fuel Values of Food. Body calorie requirements – adult consumption unit. Dietary requirements of carbohydrate, protein, lipid and other nutrients. Balanced diet and principles of formulation of balanced diets for adult man and woman. Nitrogen balance. **(4)**

CC8P.

- **Biochemical estimations:** Quantitative estimation of amino nitrogen by Sorensen's formol titration method (percentage as well as total quantity to be done). Colorimetric methods— i) Estimation of serum protein by Biuret method and serum albumin by Bromocresol green dye method and calculation of A/G ratio. ii) Estimation of blood glucose by Folin–Wu method.

(2)

CC9P.

- **Dale's Experiment** : Kymographic recording of normal movements of rat's intestine in Dale's apparatus and effects of hypoxia, acetylcholine and adrenaline on normal intestinal movements. (2)

CC10P.

- **Nutrition and Dietetics** : Diet survey report of a family as per ICMR specification. (2)

Semester V

CC11T: Special Senses

- Characteristics of special senses, Sensory Coding -- Weber-Fechner law, Steven's power law.
- **Vision**: Structure of eyeball. Histological details of retina, peripheral retina, fovea and blind spot. Retinal detachment. Visual pathway and centers. Effects of lesion in visual pathway. Mechanism of accommodation. Errors of refraction and their corrections. Formation and Circulation of Aqueous Humour. Cataract and Glaucoma. Photopic and scotopic vision. Chemical and electrical changes in retina on exposure to light. Visual processing in the retina. Positive and negative after- images. Contrast phenomenon. Light and dark adaptation. Colour vision—Trichromatic, Single and Double Opponent mechanism. Colour blindness. Visual field-- perimetry. Visual acuity – measurement, mechanism and factors affecting. Critical fusion frequency.
- **Hearing** : Structure and functional significance of auditory apparatus. Organ of Corti. Auditory pathways and centers. Mechanism of hearing – Excitation of Hair Cells, Conversion of Sound Waves into Action Potentials in the Auditory Nerve. Mechanism of discrimination of sound frequencies and intensities. Localization of sound source. Deafness.
- **Olfaction and Gustation**: Structure and functions of the receptor organs, nerve pathways, centers. Signal Transduction of olfactory and gustatory stimuli. Olfactory and Gustatory Coding. Abnormalities of olfactory and taste sensation. (4)

CC12T. Endocrinology

- **Hypothalamus** as a neuroendocrine organ. Anterior and posterior pituitary – histological structure of the gland. Chemical nature, molecular mechanism of

action, functions and regulation of secretion of their hormones. Hypo- and hyperactive states of the gland.

- **Pineal gland** – Histological structure. Chemical nature, biosynthesis, molecular mechanism of action, functions and regulation of secretion of melatonin.
- **Thyroid and Parathyroid** -- Histological structure of the glands. Chemical nature, molecular mechanism of action, functions and regulation of secretion of the hormones. Hypo- and hyperactive states of the glands.
- **Adrenal cortex and medulla** -- Histological structure of the gland. Chemical nature, molecular mechanism of action, functions and regulation of secretion of the hormones. Biosynthesis of catecholamines. Hypo- and hyperactive states of the gland.
- **Heart** as an endocrine organ.
- **Pancreatic islets** -- Histological structure. Chemical nature, molecular mechanism of action, functions and regulation of secretion of the hormones. Hormonal control of blood sugar. Hyperinsulinism and diabetes mellitus.
- **Gastro-intestinal hormones** -- Chemical nature, molecular mechanism of action, functions and regulation of secretion of the hormones. **(4)**

CC11P.

1. Determination of Visual Acuity by Snellen's Chart
2. Determination of Colour Blindness by Ishihara Chart.
3. Determination of Deafness by Tuning Fork Tests. **(2)**

CC12P.

Study of Effects of Oxytocin and Adrenaline on uterine contractions of albino rat. **(2)**

Semester VI

CC13T. Reproductive Physiology

Primary and accessory sex organs and secondary sex characters. Histology of testis. Endocrine functions of testis. Spermatogenesis. Hypothalamic control of testicular functions. Histology of ovary. Ovarian hormones and their functions. Oogenesis and ovulation. Formation and functions of corpus luteum. Hypothalamic control of ovarian functions. Physiology of puberty. Menstrual cycle and its regulation. Abnormalities in menstrual cycle. Onset of menopause and 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. **(4)**

CC14T. Excretory System

- **Kidney** : 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. Constituents of urine. Abnormal constituents of urine, and pathophysiological significance. Renal dialysis. Non-excretory functions of kidney.
- **Skin and Body Temperature Regulation** : Structure and functions of skin. Cutaneous circulation. Sweat glands –structure and composition of sweat. Mechanism of sweat formation, secretion and its regulation. Insensible perspiration. Regulation of body temperature in homeotherms – its physical and physiological processes, roles of neural and hormonal processes. Pyrexia, hyperthermia and hypothermia. **(4)**

CC13P.

1. Staining and identification of histological sections of ovary, testes, kidney and ureter.
2. Pregnancy Test by immunological method using kit. **(2)**

CC14P.

- Identification of normal and abnormal constituents of urine. **(2)**

Credit Distribution Across Courses

COURSE TYPE	TOTAL PAPERS	CREDITS
		THEORY+ PRACTICAL
Core Courses	14	14X4=56 14X2=28
Discipline Specific Electives	4	4X4=16 4X2=8
Generic Electives	4	4X4=16 4X2=8
Ability Enhancement Language Courses	2	2X2=4
Skill Enhancement Courses	2	2X2=4
TOTALS	26	140

Discipline Specific Electives (DSE) (Any FOUR)

1. Biostatistics
2. Microbiology
3. Immunology
4. Ergonomics and Occupational Physiology
5. Exercise and Sports Physiology
6. Human Nutrition and Dietetics
7. Toxicology and Pharmacology
8. Methodologies

1. Biostatistics (DSE1T)

- Scope of statistics – utility and misuse. Principles of statistical analysis of biological data.
- Basic concepts – variable. Population and Sampling -- parameter, statistic.
- Presentation of data-frequency distribution, frequency polygon, histogram, bar diagram and pie diagram.
- Different classes of statistics- mean median, mode, mean deviation, variance, standard deviation, standard error of the mean. Standard score.
- Degrees of freedom. Probability. Normal distribution. Student's t-distribution.
- Testing of hypothesis - Null hypothesis, errors of inference, levels of significance, t-test and z score for significance of differen.
- Distribution-free test - Chi-square test.
- Linear correlation and linear regression. (4)

DSE 1P

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). (2)

2. Microbiology (DSE2T)

- **Classification of microorganisms.** Techniques employed for the identification of microorganisms – microscopic and biochemical methods.
- **Control of microbial growth :** Physical and Chemical methods used in sterilization, disinfection and pasteurization.
- **Bacteriology :** Bacterial classification based on staining techniques (Gram stain and Acid-fast stain) and morphological aspect. Bacterial structure :cell-wall, LPS layer, pili, flagella, chromosome, plasmid, spores and cysts.
- **Culture of bacteria :** nutritional requirement – complex and synthetic media, preparation of media ; physical factors required for growth (temperature, pH and gaseous requirement) ; bacterial growth curve : different phases and their significance ; quantitative estimation of bacterial growth ; continuous growth culture and its utility.
Food microbiology : beneficial and harmful microorganisms in food, causative organisms of food-borne infections- mode of transmission and methods of prevention.
- **Bacterial metabolism:** fermentation, glyoxalate cycle and Entner-Doudoroff pathway.
- **Bacterial genetics :** transformation, conjugation and transduction.
- **Treatment of bacterial infection :** chemotherapeutic agents. antibiotics- definition, bactericidal and bacteriostatic and their mechanism of action.
- **Virology :** Viral structure – virion, prion and bacteriophages ; classification of viruses based on nucleic acid composition and host system, replication of bacteriophages – lytic and lysogenic cycle. (4)

DSE 2P

1. Gram staining of bacteria and identification of Gram positive and Gram negative bacteria.
2. Staining of bacterial spores.(2)

3. Immunology(DSE3T)

- **Overview of innate and acquired immunity :** Elements of acquired immunity : characteristics of immune response, cells and organs involved in immune response.
- **Immunogens and antigens :** Requirements of immunogenicity, epitopes recognized by B- & T- cells, haptens, adjuvants, cross-reactivity. Antibody structure, classification and functions.

- **Kinetics of antibody responses** : Primary & secondary. Antigen - antibody interactions - Primary interaction : association constant, affinity & avidity. Secondary interaction : precipitation & agglutination. B-cell receptor.
- **MHC molecules** : structure of class I and II molecules, brief idea of peptide binding by MHC molecules, cellular distribution.
- **Antigen processing and presentation**: T-cell receptor. T-cell maturation and differentiation - thymic selection in brief. B-cell activation & differentiation : thymus dependent and independent antibodies, T-B co-operation, the carrier effect.
- **Cytokines** : Produced by T_{H1} & T_{H2} cells, regulating specific immune response only.
- **Complement** : Activation components – classical, alternative and lectin. Biological consequence of complement activation. Cell-mediated effector responses : CTLs, NK cells, K cells.
- Immune responses in allergy. Brief idea of autoimmunity and AIDS.
- **Vaccination** : Passive and active immunization, types and uses of vaccine.
- **Toxins and toxoids.** (4)

DSE 3P

1. Determination of human blood group using immunological method.
2. Immunodiffusion.(2)

4. Ergonomics and Occupational Physiology (DSE4T)

- **Genesis and concept of ergonomics**: Importance of ergonomics in occupational health and well-being.
- **Classification of Physiological work-load.**
- **Concept of work-rest cycle.**
- **Physical work environment** : (a) Thermal environment : Effect on workers, Heat stress indices. (b) Noise and vibration : Effect on workers. Occupational deafness. (c) Illumination level : Effect on visual performance. (d) Ergonomic principles of control of physical hazards.
- **Static anthropometry** : Application of data in design. User interface and control display compatibility.
- **Industrial human safety** : Prevention of accidents.
- **Occupational diseases** : Asbestosis, Silicosis and work-related musculoskeletal disorders.
- **Ergogenic aids.**

DSE 4P

1. Measurement of working heart-rate by ten beats method.
2. Measurement of body fat percentage.
3. 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.

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

5. Exercise and Sports Physiology (DSE5T)

- Concept of endurance, strength and speed in sports activities.
 - **Energy sources during exercise** : ATP-CP System, Anaerobic System and Aerobic System.
 - **Cardio-respiratory responses during different graded exercise.**
 - **Concept of Excess Post-exercise Oxygen Consumption:** Lactate threshold, lactate tolerance and their usefulness. Physiological fatigue and recovery.
 - **Aerobic Work Capacity:** Measurement, Physiological Factors and Applications.
 - **Training** : Principles, Training to improve aerobic and anaerobic power. Effects of overtraining. Detraining.
 - **Nutritional aspects of sports.**
 - **Sports injury and its management.**
- DSE 5P**
1. Measurement of blood pressure before and after different graded exercise.
 2. Determination of PFI by Harvard Step Test (Modified).
 3. Determination of V_{O_2max} by Queen's College Step Test.
 4. Determination of endurance time by hand grip dynamometer.

6. Human Nutrition and Dietetics (DSE6T)

- Constituents of food and their significance.
- Composition and nutritional value of common Indian food stuffs.
- Balanced diet: Principles of formulation of balanced diets for growing child, pregnant woman and lactating woman.
- Proteins spacers, Supplementary value of protein. Protein efficiency ratio and net protein utilization of dietary proteins.
- Dietary fibres.
- Principle of diet survey.
- Physiology of starvation and obesity.

DSE6P

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

7. Toxicology and Pharmacology (DSE7T)

- Toxins, Toxicology, Drug and Pharmacology
- LD₅₀, LOD₅₀, ED₅₀, NOEL LOEL

The importance of pharmacology in the study of physiological processes. Definition of drug, agonist and antagonist. Drug delivery Drug reactivity. Pharmacokinetics : Drug-receptor interaction, Desensitization of receptors, Absorption, Distribution, Permeation, Elimination, Clearance, Half-life. Pharmacodynamics: dose-response curves. Beneficial versus toxic effects of

drugs. Drug biotransformation. Bioavailability. Drug accumulation. Therapeutic index. Anaesthetics : types and mechanism of action of general anaesthetics. Sedatives - hypnotics: benzodiazepine, zolpidem. Diuretics - Carbonic anhydrase inhibitor, loop diuretic, potassium sparing and osmotic diuretics. Neuromuscular blockers : Tubocurarine and succinyl choline. Organ system effects and mechanism of action of adrenoceptor agonists and antagonists:

Adrenergic stimulants : Amphetamine and ephedrine. α - adrenergic stimulants – Methoxamine and clonidine. β - adrenergic stimulants – Metaproterenol and salbutamol.

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

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

DSE7P To be set in workshop

8. Methodologies (DSE8T)

- **Principles, Method and Uses** : Agarose gel electrophoresis, SDS–PAGE, Affinity and Ion-exchange Chromatography.
- **Staining of DNA/RNA gel** : Ethidium bromide technique.
- **Principles of Ultracentrifugation**: moving boundary and density gradient.
- **Radioactivity** : Classification and properties. Uses : Radiolabelling of biomolecules and its detection by autoradiography. Principles of radioimmunoassay (RIA).
- **Principles, Method and Uses** : ELISA. Southern, Northern and Western blotting. Flow cytometry.

DSE8P

1. Preparation of a standard curve of protein by Lowry's method.
2. Paper/Thin Layer Chromatography.

Generic Elective (GE) (Any FOUR)

1. Developmental Biology
2. Instrumentation
3. Environmental Pollution and Human Health
4. Genetics and Molecular Biology
5. Chronobiology and Stress Physiology
6. Community and Public Health

Developmental Biology (GE 1T)

- **Stem cell** : Characteristics and applications.
- **Ultra structure** : Sperm and Ovum.
- **Fertilization, Placentation and Blastula formation.**
- **Gastrulation** : Mammals—Concept of induction, determination and differentiation.
- **Organogenesis** : Development of Heart, Kidney and Gonads.
- **Fetal Circulation.**

Developmental Biology (GE 1P) To be set in workshop

Instrumentation (GE 2T)

- **Principles of construction and uses** : Compound microscope, Phase contrast microscope, Fluorescence microscope, Polarizing microscope, Confocal microscopy, Transmission and Scanning electron microscope, Photoelectric colorimeter, Spectrophotometer, Spectrofluorometer and pH meter.
- Brief idea on uses of CRO, CT scan, fMRI and PET.

Instrumentation (GE 2P) H & E staining of ovarian tissue sections and identification of Graafian follicle, Corpus luteum. Demonstration of preserved mammalian embryo.

Environmental Pollution and Human Health (GE 3T)

- **Air Pollution** : Sources of pollutants, Effects on human health. Concept of ozone hole, greenhouse effects and global warming.
- **Water Pollution** : Sources of pollutants, Effects on human health. Biochemical Oxygen Demand. Thermal Pollution. Safe Drinking Water.
- **Sound Pollution** : Sources, Noise, Effects on human health. Noise Index.
- **Radionuclide Pollution** : Ionizing and Non-ionizing Radiations. Effects on human health. Permissible Doses.
- **Arsenic Pollution** : Sources, Drinking Water Standard for Arsenic (WHO & USEPA). Effects of chronic arsenic poisoning.

Environmental Pollution and Human Health (GE 3P)

Determination of BOD and COD.

Genetics and Molecular Biology (GE 4T)

- **Genetics** : Mendelism. Epistasis in human. Penetrance, Expressivity, Pleiotropism. Crossing-over, Linkage and Gene Mapping. Chromosomal Aberrations.
- **Human Cytogenetics** : Karyotype,,Banding Technique, Uses in Medical Science. Inborn Errors of Metabolism. Aneuploidy in human. Sex determination—Role of *sry* gene. Sex-linked Inheritance.
- **Molecular Biology** : Genes – definition. DNA Replication, Transcription of RNA in prokaryotes, Genetic code – Properties and Wobble Hypothesis. Translation in prokaryotes. Regulation of gene expression – Operon concept : *Lac* operon. Gene mutation. DNA repairing processes.

Genetics and Molecular Biology (GE 4P)

1. DNA gel electrophoresis.
2. Problems on Mendelian Genetics.

Chronobiology and Stress Physiology (GE5T)

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

Chronobiology and Stress Physiology (GE5P)

Assessment of individual differences in human circadian rhythms (chronotype in human population) by questionnaire method among school children and college students.

Community and Public Health (GE6T)

- Basic idea about community,public health issues.
- Malnutrition in a community, overnutrition and possible remedial measures.
- Diet management of obese, diabetic, hypertensive and athlete.
- Basic idea of PCM and their prevention.
- Iron and iodine deficiency.

Community and Public Health (GE6P)

1. Assessment of noise level using a noise-level meter.
2. Audiometry.

Skill Enhancement Course (SEC) (Any two)

1. Detection of Food Additives /Adulterants
2. Clinical Biochemistry
3. Hematological Techniques
4. Bio-Medical Technology
5. Diet Survey and formulation of Diet Chart

1. Detection of Food Additives /Adulterants

Definition ,examples and health hazards of food additives/adulterants. Qualitative tests for identifying Food Adulterants in some food samples: Metanil yellow, Rhodamin B, Saccharin, Monosodium glutamate, Aluminium foil, Chicory, Bisphenol A and Bisphenol S, Chocolate Brown HT, Margarine, Pb, Hg, As, PCB, Dioxin etc in turmeric powder, besan, laddoo, noodles, chocolate and amriti.

2. Clinical Biochemistry

Pathophysiological significance of the following blood constituents:

glucose, serum protein, albumin, urea, creatinine, uric acid, , bilirubin, SGPT and SGOT, alkaline and acid phosphatases and ketone bodies. Lipid profile.

3. Haematological techniques

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, Arneht count, PCV, MCV, MHC, MCHC, bleeding time,

clotting time and prothrombin time. Anaemia - types (definition and causes). Leucocytosis, leucopenia and leukaemia.

Purpura.

4. Bio-Medical Technology

Recording and analysis of electro cardiac activities using ECG machines. Lung function tests using Spirometer and analysis of the results. Measurement of

physiological parameters using simple Bioimpedance machines and analysis of the results.

5. Diet Survey and formulation of Diet Chart

Survey of dietary status of people in the nearby area or community by students, analysis of survey results and formulation of diet chart. Diet in obesity, diet in diabetes mellitus, diet in gout..