

Vidyasagar University

Curriculum for B.Sc. Honours in Physiology [Choice Based Credit System]

Semester-I

Sl. no.	Name of the Subject	Nature	Code	Teaching Scheme in hour per week			Credit	Marks
				L	T	P		
C1	C1T: Cellular Basis of Physiology	Core Course-1		4	0	0	6	75
	C1P: Histology (Practical)	Core Course1 [Practical]		0	0	4		
C2	C2T: Biological Physics and Enzymes	Core Course-2		4	0	0	6	75
	C2P: Biological Physics and Enzymes (Practical)	Core Course-2 [Practical]		0	0	4		
GE-1	GE-1	GE					4/5	75
	GE-1	GE					2/1	
AECC	English	AECC					2	50
Total Credits =20								

L=Lecture, T=Tutorial, P=Practical

AECC- Ability Enhancement Compulsory Course: English /Modern Indian Language

Interdisciplinary/Generic Elective (GE) from other Department

[Four papers are to be taken and each paper will be of 6 credits]:

[Papers are to be taken from any of the following discipline]: Physics/Chemistry/Statistics/Computer Sc /Microbiology/Bio Technology/Zoology/Botany/Nutrition

Semester -1

Core Courses

CC-1: Cellular Basis of Physiology **Credits 06**

C1T1 : Cellular Basis of Physiology **Credits 04**

Cell Biology and Structural Units of Human System:

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

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

Development and organization of different organs and systems.

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

C1P1 : Histology **Credits 02**

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

Bone, Cartilage, Trachea, Lungs, Spleen, Lymph gland, Esophagus, Stomach, Duodenum, Ileum, Jejunum, Large Intestine, Liver, Kidney, Ureter, Salivary glands, Pancreas, Adrenal gland, Thyroid gland, Testes, Ovary, Spinal Cord, Cerebral cortex, Cerebellum, Skin, Cardiac muscle, Skeletal muscle, Smooth muscle, Artery, Vein, Tongue, Uterus.

CC-2: Biological Physics and Enzymes **Credits 06**

C2T2: Biological Physics and Enzymes **Credits 04**

- Units for measuring concentration of solutes: Moles, Equivalents, Osmoles
- Bonds and Forces in Bio-molecules

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

- Flow and Pressure and Ultracentrifugation

Basic principle and use of light, phase contrast, electron microscopy, atomic force microscopy and fluorescence microscopy. Spectrophotometer.

Principle of chromatography, ion exchange, gel filtration, GLC, TLC and immune-affinity chromatography. Electrophoresis: SDS-PAGE and agarose gel. Cell fractionation: Homogenization and ultrasonication, Ultracentrifugation. Differential and density gradient centrifugation for separation of cell fractions. Radio activity – use of radio isotopes in physiological studies.

- Nanoparticles and its application in Physiology
- Laminar and Streamline flow

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

C2P2: Biological Physics and Enzymes

Credits 02

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

Generic Elective Syllabus

GE-1 [Interdisciplinary for other department]

GE-1: Blood and Immune System and Cardiovascular system Credits 06

GE-1T1: Blood and Immune System and Cardiovascular system Credits 04

A. Blood and Immune System

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

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

B. Cardiovascular system

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

GE-1P1: Practical

Credits 02

- A. TC of WBC, DC of WBC (with Leishman stain), Haemoglobin estimation by haematometer, Haemin crystal. BT, CT & Blood group.
- B. Measurement of HR,PFI, Step Test. BP: systolic, diastolic, mean arterial blood pressure, pulse pressure by Riva- Royce mercury manometer

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Semester-II

Sl. no.	Name of the Subject	Nature	Code	Teaching Scheme in hour per week			Credit	Marks
				L	T	P		
C3	C3T: Physiology of Nerves & Muscle cells	Core Course-3		4	0	0	6	75
	C3P: Histological Study, Experiment of Nerve and Muscle	Core Course-3 [Practical]		0	0	4		
C4	C4T: Chemistry of Bio-molecules	Core Course-4		4	0	0	6	75
	C4P: Biological Chemistry(Practical)	Core Course-4 [Practical]		0	0	4		
GE-2	GE-2	GE					4/5	75
	GE-2	GE					2/1	
AECC-2	Environmental Studies	AECC					4	100
				Total Credits =22				

L=Lecture, T=Tutorial, P=Practical

AECC- Ability Enhancement Compulsory Course: Environmental Studies.

Interdisciplinary/Generic Elective (GE) from other Department

[Four papers are to be taken and each paper will be of 6 credits]:

[Papers are to be taken from any of the following discipline]:

**Physics/Chemistry/Statistics/Computer Sc/Microbiology/Bio Technology/Zoology
 /Botany/Nutrition**

Semester -II
Core Courses

Core – 3

CC-3: Physiology of Nerve & Muscle Cells **Credits 06**

C3T: Physiology of Nerve & Muscle Cells (Theory) **Credits 04**

1. Excitable Tissue: Nerve

Introduction
Nerve Cells
Excitation & Conduction
Measurement of Electrical Events
Ionic Basis of Excitation & Conduction
Properties of Mixed Nerves
Nerve Fiber Types & Function
Neurotrophins
Glia

2. Excitable Tissue: Muscle

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

3. Synaptic & Junctional Transmission

Introduction
Synaptic Transmission
 Functional Anatomy
 Electrical Events at Synapses
 Inhibition & Facilitation at Synapses
 Chemical Transmission of Synaptic Activity
 Principal Neurotransmitter Systems
 Synaptic Plasticity & Learning
Neuromuscular Transmission
 Neuromuscular Junction

Denervation Hypersensitivity

4. Initiation of Impulses in Sense Organs

Introduction

Sense Organs & Receptors

The Senses

Electrical & Ionic Events in Receptors

“Coding” of Sensory Information

C3P: Histological Study, Experiment of Nerve and Muscle (Lab)

Credits 02

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

Preparation of sciatic nerve innervated gastrocnemius muscle of toad.

Study of Kymograph, Induction coil, Key and other instruments used to study mechanical responses of skeletal muscle.

Kymographic recording of mechanical responses of gastrocnemius muscle to a single stimulus and two successive stimuli.

Kymographic recording of the effects of variations of temperature and load (after-load) on single muscle twitch.

Calculation of work done by the muscle.

Determination of nerve conduction velocity.

Core – 4

CC-4: Chemistry of Bio-molecules

Credits 06

C4T: Chemistry of Bio-molecules (Theory)

Credits 04

Classification, structure, Properties and Functions of Carbohydrates, Proteins and lipids. Structure, types and Function of DNAs and RNAs.

C4P: Biological Chemistry(Lab)

Credits 02

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

Generic Elective Syllabus

GE-2 [Interdisciplinary for other department]

GE- 2 : Developmental Biology / Embryology **Credits 06**

GE 2 T : Developmental Biology / Embryology **Credits 04**

Gametogenesis: Spermatogenesis & Oogenesis. ,Ultra structure: sperm and ovum in mammals. Egg Membranes,

Fertilization: In Sea-urchin and mammals

Cleavage: Cleavage plane, types, role of yolk in cleavage; cleavage process in mammals.

Blastula formation: mammals Morphogenetic movements: Types and examples.

Gastrulation: Mammals Concept of induction, determination, and differentiation.

Organogenesis: development of eye as an example of reciprocal and repeated inductive events.

GE2 P: Developmental Biology / Embryology (Lab) **Credits 02**

H & E staining of ovarian tissue sections and identification of Graafian follicle, Corpus Luteum, and demonstration of preserved mammalian embryo.

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Semester-III

Course	Course Code	Name of the Subjects	Course Type/ Nature	Teaching Scheme in hour per week			Credit	Marks
				L	T	P		
CC-5		C5T:Circulating Body Fluids	Core Course - 5	4	0	0	6	75
		C5P:Hematological Experiments		0	0	4		
CC-6		C6T:Circulation	Core Course - 6	4	0	0	6	75
		C6P:Cardiovascular Physiology Experimental		0	0	4		
CC-7		C7T: Functions of the Nervous System	Core Course - 7	4	0	0	6	75
		C7P: Neurological Experimental		0	0	4		
GE-3		TBD	Generic Elective -3				4/5	75
SEC-1		SEC1T: Detection of Food Additives / Adulterants Or SEC1T: Clinical Biochemistry	Skill Enhancement Course-1	1	1	0	2	50
Semester Total							26	350

L=Lecture, T= Tutorial, P=Practical, CC = Core Course, GE= Generic Elective, SEC = Skill Enhancement Course, TBD = to be decided

Generic Elective (GE) (Interdisciplinary) from other Department [Four papers are to be taken and each paper will be of 6 credits]: Papers are to be taken from any of the following discipline: **Physics/Chemistry/Statistics/Computer Sc/Microbiology/Bio Technology/Zoology/Botany/ Nutrition**

Modalities of selection of Generic Electives (GE): A student shall have to choose **04** Generic Elective (GE1 to GE4) strictly from **02** subjects / disciplines of choice taking exactly **02** courses from each subjects of disciplines. Such a student shall have to study the curriculum of Generic Elective (GE) of a subject or discipline specified for the relevant semester.

Semester-III
Core Course (CC)

CC-5: Circulating Body Fluids **Credits 06**
C5T: Circulating Body Fluids **Credits 04**

Introduction, Blood, Bone Marrow, White Blood Cells, Immune Mechanisms, Platelets, Red Blood Cells, Blood Types, Plasma, Hemostasis, Lymph, Clinical implications

C5P: Hematological Experiments **Credits 02**

Practical:

Preparation and staining of blood film with Leishman's stain.
Identification of the blood corpuscles.
Differential count of WBC.
Total count of RBC and WBC.
Bleeding time and clotting time.
Hemoglobin estimation.
Preparation of haemin crystal.
Preparation and staining of bone marrow.
Measurement of diameter of megakaryocyte.
Reticulocyte staining.
Blood group determination.

CC-6: Circulation **Credits 06**

C6T: Circulation **Credits 04**

1. Origin of the Heartbeat & the Electrical Activity of the heart

Introduction
Origin & Spread Of Cardiac Excitation
The Electrocardiogram
Cardiac Arrhythmias
Electrocardiographic Findings in Other Cardiac & Systemic Diseases, hypertrophy and cardiac myopathy

2. The Heart as a Pump

Introduction
Mechanical Events of the Cardiac Cycle
Cardiac Output

3. Dynamics of Blood & Lymph Flow

Introduction
Anatomic Considerations
Biophysical Considerations
Arterial & Arteriolar Circulation
Capillary Circulation
Lymphatic Circulation & Interstitial Fluid Volume

- Venous Circulation
- 4. Cardiovascular regulatory Mechanisms**
 - Introduction
 - Local Regulatory Mechanisms
 - Substances Secreted by the Endothelium
 - Systemic Regulation by Hormones
 - Systemic Regulation by the Nervous System
- 5. Circulation Through special Regions**
 - Introduction
 - Cerebral Circulation
 - Anatomic Considerations
 - Cerebrospinal Fluid
 - The Blood-Brain barrier
 - Cerebral Blood Flow
 - Regulation of Cerebral Circulation
 - Brain Metabolism & Oxygen Requirements
 - Coronary Circulation
 - Splanchnic Circulation
 - Circulation of the skin
 - Placental & Fetal Circulation
- 6. Cardiovascular Homeostasis in Health & Disease**
 - Introduction
 - Compensation for Gravitational Effects
 - Exercise
 - Inflammation & Wound Healing
 - Shock
 - Hypertension
 - Heart Failure, stroke

C6P: Cardiovascular Physiology Experimental

Credits 02

Practical:

Preparation of Amphibian Ringer solution.

Kymographic recording of the movements of perfused heart of toad.

Study of the effects of changes in perfusion fluid pressure, changes in temperature, excess calcium and potassium ion concentration, acetylcholine, adrenaline on the on the movement of heart.

CC-7: Functions of the Nervous System

Credits 06

C7T: Functions of the Nervous System

Credits 04

1. Reflexes

Introduction

Monosynaptic Reflexes: The Stretch Reflex

Polysynaptic Reflexes: The Withdrawal Reflex
General Properties of Reflexes

2. Cutaneous, Deep & Visceral Sensation

Introduction

Pathways

Touch

Proprioception

Temperature

Pain

Other Sensations

3. Arousal Mechanisms, Sleep, & the Electrical Activity of the Brain

Introduction

The Reticular Formation & the Reticular Activating System

The Thalamus & the Cerebral Cortex

Evoked Cortical Potentials

The Electroencephalogram

Physiological Basis of the EEG, Consciousness, & Sleep

Interpretation of abnormal EEG pattern

4. Control of Posture & Movement

Introduction

General Principles

Corticospinal & Corticobulbar System

Anatomy & Function

Posture and its regulation

Basal Ganglia

Cerebellum

Movement disorders

5. The Autonomic Nervous System

Introduction

Anatomic Organization of Autonomic Outflow

Chemical Transmission at autonomic Junctions

Responses of Effector Organs to Autonomic Nerve Impulses

Cholinergic and Adrenergic Discharge

6. Central Regulation of Visceral Function

Introduction

Medulla Oblongata

Hypothalamus

Anatomic Considerations

Hypothalamic Function

Relation to Autonomic Function

Relation to Sleep

Relation to Cyclic Phenomena

Hunger

Thirst
Control of Posterior Pituitary Secretion
Control of Anterior pituitary Secretion
Temperature Regulation, fever

7. Neural Basis of Instinctual Behavior & Emotions

Introduction
Anatomic Considerations
Limbic Functions
Sexual Behavior
Fear & Rage
Motivation

8. “Higher Functions of the Nervous System”: Conditioned Reflexes , Learning, & Related Phenomena

Introduction
Methods
Learning & Memory
Functions of the Neocortex
Disorders relating learning and memory

C7P: Neurological Experimental

Credits 02

Practical:

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

Skill Enhancement Course (SEC)

SEC-1: Detection of Food Additives / Adulterants

Credits 02

SEC1T: Detection 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.

OR

SEC-1: Clinical Biochemistry

Credits 02

SEC1T: Clinical Biochemistry

Photo-colorimetric estimation of blood constituents. Measurement of blood glucose by Nelson-Somogyi method, measurement of blood inorganic phosphate by Fiske - Subbarow method, measurement of serum total protein by Biuret method and determination albumin globulin ratio, determination of serum amylase by iodometric method.

Generic Elective Syllabus

GE-3 [Interdisciplinary for other department]

GE-3: Community and Public Health

Credits 06

GE3T: Community and Public Health

Credits 04

Basic idea about community health and public health issues, Malnutrition in a community, overnutrition, issues of obesity; possible remedial measures. Composition and nutritional value of common Indian foodstuffs, rice, wheat, pulses, egg, meat, fish and milk. Dietary fibers. Calorie requirement. Concept of ACU. Principles of formulation of balanced diets for growing child, adult man and woman, pregnant and lactating woman. Diet management of obese, diabetic, hypertensive person and athlete. Basic idea on PCM, marasmus, kwashiorkor and their prevention. Iron and iodine deficiency.

Sound pollution as a community health issue; definition, concept of noise, source of extraordinary sound, effects of sound pollution on human health, noise index (noise standards).

GE-3P: Community and Public Health

Credits 02

Qualitative assessment of noise, survey on the status of dietary intake in the surrounding area through visits, etc.

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Semester-IV

Course	Course Code	Name of the Subjects	Course Type/ Nature	Teaching Scheme in hour per week			Credit	Marks
				L	T	P		
CC-8		C8T: Energy Balance, Metabolism and Nutrition	Core Course - 8	4	0	0	6	75
		C8P: Energy Balance, Metabolism and Nutrition (Lab)		0	0	4		
CC-9		C9T: Gastrointestinal Function	Core Course - 9	4	0	0	6	75
		C9P: Gastrointestinal Function (Lab)		0	0	4		
CC-10		C10T:Respiratory Physiology	Core Course - 10	4	0	0	6	75
		C10P: Respiratory Physiology(Lab)		0	0	4		
GE-4		TBD	Generic Elective -4				4/5	75
							2/1	
SEC-2		TBD	Skill Enhancement Course-2	1-1-0/1-0-2			2	50
Semester Total							26	350

L=Lecture, **T**= Tutorial, **P**=Practical, **CC** = Core Course, **GE**= Generic Elective, **SEC** = Skill Enhancement Course, **TBD** = to be decided

Generic Elective (GE) (Interdisciplinary) from other Department: Papers are to be taken from any of the following discipline: **Physics/Chemistry/Statistics/Computer Sc/Microbiology/Bio Technology/Zoology/Botany/ Nutrition**

Modalities of selection of Generic Electives (GE): A student shall have to choose **04** Generic Elective (GE1 to GE4) strictly from **02** subjects / disciplines of choice taking exactly **02** courses from each subjects of disciplines. Such a student shall have to study the curriculum of Generic Elective (GE) of a subject or discipline specified for the relevant semester.

Semester-IV
Core Course (CC)

CC-8: Energy Balance, Metabolism and Nutrition

Credits 06

C8T: Energy Balance, Metabolism and Nutrition

Credits 04

Introduction

Energy metabolism

Carbohydrate metabolism

Biological oxidation

Protein metabolism

Fat and cholesterol metabolism

Integration of carbohydrate, fat and protein metabolism

Reactive Oxygen Species

Nutrition – Basic concepts of nutrients, nutraceutical, cosmoceutical, nutrigenomics.

Nutrition – BMR, RQ, RDA, SDA, NPU, Biological value of proteins, vitamins and minerals. Energy in Human nutrition.

C8P: Biochemical Estimation

Credits 02

- a. Quantitative estimation of glucose and sucrose by Benedict's method.
- b. Quantitative estimation of amino nitrogen [Sorensen's formol titration method (percentage as well as total quantity to be done)].
- c. Estimation of percentage quantity of lactose in milk by Benedict's method.

CC-9: Gastrointestinal Function

Credits 06

C9T: Gastrointestinal Function

Credits 04

1. Digestion & Absorption

Introduction

Carbohydrates

Proteins & Nucleic Acids

Lipids

Absorption of Water & Electrolytes

Absorption of Vitamins & Minerals

2. Regulation of Gastrointestinal Function

Introduction

General Considerations

Gastrointestinal hormones

Mouth & Esophagus

Stomach

Exocrine Portion of the Pancreas

Liver & Biliary System

Small Intestine, Colon

Mechanism, function and regulation of mastication, deglutition, movements of alimentary canal.

C9P: Gastrointestinal Function Lab

Credits 02

Dale's Experimental

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

CC-10: Respiratory Physiology

Credits 06

CC10T: Respiratory Physiology

Credits 04

1. Pulmonary Function

Introduction, Properties of gases. Anatomy of the lungs. Mechanics of breathing. Gas exchange in the lungs. Pulmonary circulation. Other functions of the Respiratory System.

2. Gas transport between the Lungs & the tissues

Introduction. Oxygen transport. Carbon Dioxide transport. Respiratory acidosis and alkalosis

3. Regulation of Respiration

Introduction. Neural control of Breathing. Chemical Control of Breathing. Nonchemical influences on Respiration

4. Respiratory adjustments in Health & Disease

Introduction. Effects of exercise. Other forms of Hypoxia. Oxygen treatment, O₂ toxicity. Hypercapnia & Hypocapnia. Other respiratory abnormalities. Sleep and Respiration. Effects of increased Barometric Pressure. Artificial respiration. Respiratory failure. High altitude sickness. Lung Function Tests.

CC10P: Respiratory Physiology Lab

Credits 02

Practical:

Respiratory Human Experiments

- a. Measurement of peak expiratory flow rate
- b. Measurement of oxygen saturation by pulse oxymeter before and after exercise
- c. Measurement of forced expiratory volume (FEV) in first second.

Skill Enhancement Course (SEC)

SEC-2: Computer application in Health science

Credits 02

SEC2T: Computer application in Health science

Credits 01

Course Contents:

Importance of computer application in biological sciences and medicine. Brief history of development of computer. Generation of Computer. Classification of computer – analogue, digital, hybrid, micro, mini, mainframe and super computers. Computer hardware: Different components of computer. Computer Software – types of software - monitor program and operating system, utility program, application program. Computation of data – mean, median, mode, SD, SEM & t-value. Graphical representation of data in pie, bar and line diagram using Microsoft excel, Power Point: Preparation of body text and table by using MS word. Slide preparation for Physiological items. Presentation of study material by using power point. e-mail, internet- concepts.

Application of computer in physiology and medicine. Application of computer in physiological data analysis – M.S. Word, Excel. M.S. Excel: Basic application in physiology. Use of computer by dietitian and dietary computation.

Physiological Modeling: Concepts, Computer in physiological models. Human Brain and Computer. Computer and their use in medical field. Basics of computer assisted imaging. Computer assisted therapy in health science.

SEC2P: Computer application in Health science

Credit 01

1. Basic operation of computer: Operations of WINDOWS; data entry.
2. Graphical presentation of data. Computer tabulation of physiological data. Making charts with Ms Excel - bar diagram, line diagram, pie diagram for representing physiological data.
3. Computation of frequency and percentage distribution of different physiological parameters in different age groups, in different communities, percentage distribution of blood groups.
4. Significance of testing by 't' test with interpretation – Paired observation, standard/population mean.
5. Power point - making slide for any topic related to physiology or medicine, editing, slide show.

6. Preparation of case history of a patient and feeding of information in the hard disc.

Or

SEC-2: Physiological Techniques and Public Health Assessments **Credits 02**

SEC2T: Physiological Techniques and Public Health Assessments **Credits 01**

Course Contents:

Physiological Techniques:

Audiometry, Perimetry, Visual Acuity, Colour Blindness, EMG, EEG ,ECG, Nerve Conduction velocity, Autonomic Status assessment (Valsalva maneuver), Deep breathing test, Reaction time (Choice), Stereotactic techniques.

Public Health assessment:

Nutritional status of children and adults: Growth curves (Height-for-age, Weight –for-age, weight-for-height, BMI-for-age) for detection of stunting, under weight, wasting, thinness, overweight and obesity. Somatotype for adult (Health – Carter method). Socioeconomic status assessment (Kuppaswamy’s Socioeconomic scale)

SEC2P: Practical

Credit 01

1. Growth charts – plotting growth charts for growth monitoring.
2. Calculation of BMI of an individual and interpretation of results.
3. Prepare growth curves for stunting, under weight, wasting and obese person.
4. To map the peripheral field of vision with perimeter(Perimetry)
5. Mapping of physiological blind spot and calculation of optic disc size.
6. Determination of visual acuity by Snellen’s chart/Landolt’s chart..
7. Determination of colour blindness by Ishihara Charts.
8. Recording of auditory and visual reaction time.
9. Somatotyping of Human subjects.
10. Survey of dietary status of people in the nearby area by students, analysis of survey results and formulation of diet charts.
11. Submit a socioeconomic status assessment report.
12. To study the phenomenon of fatigue by Mosso’s ergograph.
13. Audiometry (Demonstration).
14. Recording of human electrocardiogram (ECG) (Demonstration).
15. Recording of electroencephalogram (EEG) (Demonstration).

Or

SEC-2: Histopathological Techniques

Credits 02

SEC2T: Histopathological Techniques

Credits 01

Course Contents:

Unit-I

Introduction of histopathology: cellular physiology and Pathology. Evolution of histology. Quality control in histopathology. Histological laboratory organization, care & maintenance of equipments used in histopathology laboratory. Fixation and fixatives : Types and mechanism Microtome, its type. Staining theory: Stains and dyes, dye types. mordant, accelerators. silver impregnations. Haematoxylin and Eosin staining, Mounting and mounting media, Tissue processing and its steps. Decalcification. Embedding media - types and properties. Cryotomy, cryostat, impregnation techniques, frozen sections and staining for emergency diagnosis

Unit-II:

Histochemistry : General consideration, limitation to histochemistry. PAS reactions, Sudan Black, Perchloric acid/ Napthaquinone reaction(PAN). Histochemistry of Nuclie acids, proteins and enzymes – basic concept, process, and quantitation of enzyme activity. Histochemistry of Pigments.

Unit-III:

Immunological Techniques : Principles, types, application. Antibody as histological reagents, autoradioactivity. Exfoliative cytology – advantage and disadvantage, Gynaecological smear, fluid sample, thick fluid sample.

Unit -IV:

Cytogenetics & Molecular Techniques: Cytogenetics , chromosomal studies. Karyotyping, growth of cells in tissue cultures. DNA hybridization techniques.

Microscopy : Light Microscopy – types, procedure, tissue preparations, photomicrography. Electron Microscopy : Types, Principle, tissue preparation & techniques.

SEC2P: Histopathological Techniques

Credits 01

Practical:

1. Glass wares and equipment used in histopathology lab.To prepare alcohol of different concentration. To prepare formalin from stock solution.
2. Preparation of tissue sections, To perform section cutting of paraffin embedded tissue.
3. H&E staining of tissue sections,

4. Preparation and staining of bone marrow smear,
5. Measurement of diameter of megakaryocyte,
6. Reticulocyte staining,
7. Staining of collagen in tissue sections.
8. PAP staining techniques.
9. Staining carbohydrates with PAS reaction.
10. Sudan Black staining (Demonstration)

Or

SEC-2: Sports Medicine & Nutritional Physiology

Credits 02

SEC2T: Sports Medicine & Nutritional Physiology

Course Contents:

Introduction: Concept of Sports medicine. Aims and objectives of sports medicine. Need and Scope of Sports Medicine. Role of Sports Physician, Physical Educator / Sports Coaches in Sports Medicine.

Basic kinesiology: Meaning and definition of Kinesiology. Importance of Kinesiology for games and sports. Kinesiological classification of muscle. Role of muscles. Joints and their Movements.

Sports Injuries: Introduction. Types of Sports injuries. Reasons of sports injuries. Prevention and management of Sports injuries.

Therapeutic modalities: Brief description of therapeutic modalities. Role of ice in treatment of sports injuries. Clinical application of heat modalities. Brief concepts of Short wave Diathermy (SWD), Whirlpool Bath, Transcutaneous Electrical Nerve Stimulation (TENS). Interferential Stimulation..

Nutritional Physiology & Athlete:

Nutritional parameters of athletics performances including intervention planning, energy production, energy nutrients, vitamins and minerals, Timing and composition of intakes. Planning and preparation of diets for younger and older athletics of various categories – age group, gender and sports type. Weight management strategies for sports persons. Planning and preparation of diets for sports persons suffering from anemia and osteoporosis.

Suggested Readings:

1. Steven Ray, Irvin Richer. Sports Medicine, Prentice Hall,1983.
2. Vinger and Roerner. Sports Injuries, PSG Publishing Co., Inc.,
3. Williams, JGP. Sports Medicine . London Edward Arnold Pub.
4. Morehouse and Rash, Sports Medicine for Trainer, WB Saunders.
5. Armstrong and Trucker, Injuries and Sports, London Scampless Press.

Generic Elective (GE)
[Interdisciplinary for other department]

GE-4: Nerve -Muscle Physiology, Nervous system and Sensory Physiology Credits 06

GE4T: Nerve -Muscle Physiology, Nervous system and Sensory Physiology Credits 04

Course Contents:

A. Nerve - Muscle Physiology

1. Excitable Tissue: Nerve Introduction, Nerve Cells, Excitation & Conduction, Measurement of Electrical Events, Ionic Basis of Excitation & Conduction, Properties of Mixed Nerves, Nerve Fiber Types. Neurotrophin. Regeneration and Degeneration of nerve fibers.

2. Excitable Tissue: Muscle: Introduction, Skeletal Muscle: Morphology, Electrical Phenomena & Ionic Fluxes, Contractile Responses, Properties. Cardiac Muscle: Morphology, Electrical Properties, Mechanical Properties Pacemaker Tissue, Smooth Muscle: Morphology.

3. Synapse and Neuro muscular Junction: Introduction, Synaptic Transmission: Functional Anatomy, Electrical Events at Synapses, Inhibition & Facilitation at Synapses, Chemical Transmission of synaptic activity. Neurotransmitter. EPSP,IPSP.

Neuro muscular Junction: Introduction, structure, transmission of impulse. Electromyography.

4. Initiation of Impulses in Sense Organs Introduction, Sense Organs & Receptors, The Senses, Electrical & Ionic Events in Receptors, “Coding” of Sensory Information.

B. Nervous system

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

2. Cutaneous, Deep & Visceral Sensation Introduction, Pathways Touch, Proprioception, Temperature, Pain.

3. Arousal Mechanisms, Sleep, & the Electrical Activity of the Brain The Reticular Formation & the Reticular Activating System, The Thalamus & the Cerebral Cortex: structure & functions. The Electroencephalogram, Physiological Basis of the EEG & Sleep, Interpretation of abnormal EEG pattern.

4. Control of Posture & Movement Introduction, General Principles, Basal Ganglia & Cerebellum: Structure & functions. Movement disorders.

5. The Autonomic Nervous System Introduction, Anatomic Organization of Autonomic Outflow, Chemical Transmission at autonomic Junctions.

6. Central Regulation of Visceral Function Introduction, Hypothalamus: Anatomic Considerations, Hypothalamic Function, Relation to Autonomic Function, Relation to Sleep, Hunger, Thirst, Control of Posterior Pituitary Secretion, Control of Anterior pituitary Secretion, Temperature Regulation, fever.

7. Neural Basis of Instinctual Behavior & Emotions Introduction, Limbic system: Anatomic Considerations, Functions - Sexual Behavior, Fear & Rage, Motivation,

C. Special sense

Vision: Anatomic Considerations, The Image-Forming Mechanism (accommodation and visual acuity), The Photoreceptor Mechanism: Genesis of Electrical Responses, Visual Pathways and effects of lesions of these pathways, Color Vision, Errors in visual process.

Hearing & Equilibrium: Introduction, Anatomic considerations, Hair cells, Mechanism of hearing, Vestibular function.

Smell & Taste: Introduction, Smell: Receptors & Pathways. Taste: Receptor Organs & Pathways.

GE4P: Histological Study and Experiments of Nerve and Muscle

Credit 02

Practical:

1. Isolation and Staining of nerve fibers with node(s) of Ranvier (AgNO₃) and muscle fibers (Haematoxylin and Eosin).
2. Measurement of grip strength.
3. Determination of visual acuity by Snellen's chart / Landolt's C chart.
4. Determination of colour blindness by Ishihara chart.

Demonstration:

Study of Kymograph, Induction coil, Key and other instruments used to study mechanical responses of skeletal muscle.

Kymographic recording of mechanical responses of gastrocnemius muscle to a single stimulus and two successive stimuli.

Kymographic recording of the effects of variations of temperature and load (after-load) on single muscle twitch.

Calculation of work done by the muscle.

Determination of nerve conduction velocity.

Neurological experiments:

Experiments on superficial (plantar) and deep (knee jerk) reflex.

Reaction time by stick drop test.

Short term memory test (shape, picture word).

Two point discrimination test.

Principles of fixation and staining, Staining and identification of fixed endocrine glands and nervous tissue.

Or

GE-4: Excretory System & Body Temperature Regulation

Credits 06

GE4T: Excretory System & Body Temperature Regulation

Credits 04

Course Contents:

Renal Function & Micturition:

Introduction, Juxta Glomerular Apparatus, Function of Malpighian corpuscles and renal tubule, counter-current mechanism, Water Excretion, Acidification of the Urine & Bicarbonate Excretion, Regulation of Na⁺ & Cl⁻ Excretion, Renal Circulation, Disorders of Renal Functions, Filling of the Bladder, Emptying of the Bladder, Non-excretory function of kidney. Diuretics.

Skin and Body temperature regulation:

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

Normal body temperature. Channels of heat loss and heat gain process. Regulation of body temperature: Higher centre and mechanism of regulation. Hypothermia and Hyperthermia. Physiological basis of fever. Cold stress. Insulating effects. Acclimatization to colds.

GE4P: Excretory System & Body temperature regulation (Lab)

Credits 02

Practical

1. Identification of normal constituents of urine.
2. Identification of abnormal constituents of urine.
3. Tests for Urinary deposits.
4. Estimation of albumin in urine.
5. Detection of specific gravity of urine.
6. Quantitative estimation of Urea in Urine.
7. Recording of Body Temperature.
8. To study the response of the skin to blunt injury (triple response)(Demonstration).

Or

GE-4: Environmental pollution and Human health

Credits 06

GE4T: Environmental pollution and Human health

Credits 04

Course Contents:

Environment & Health : Definition concepts, components. Major environmental health problems in industrialized and developing countries. Occupational Health. Occupational diseases. Occupational safety.

Environmental Pollution and its impacts on Human health : **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 management - bioremediation, phytoremediation. **Sound Pollution:** definition, concept of noise, source of sound pollution, effects of sound pollution on human health, noise index (noise standards). **Radionuclide Pollution:** ionizing radiations, effects of ionizing radiation on human health, permissible doses. **Arsenic Pollution:** sources, sources of arsenic in ground water, drinking water standard for arsenic (WHO, USEPA), health effects of chronic arsenic poisoning.

Source, health problems and preventions of Bio- medical waste & e-waste.

Environment and Health impacts assessment – Concept, Steps and application.

GE4P: Environmental pollution and human health

Credits 02

I. Physiological (experimental) Experiments:

Kymographic recordind of the effects of Hg, Pb and As compounds on: The contraction of perfused heart of toad. The intestinal movements of rats in Dale's bath.

II. Histo-chemical Experiments: Histochemical studies: chronic effects of food additives and arsenic compounds on liver, kidney, intestine, brain, muscle and lung tissues in rat.

Vidyasagar University

Curriculum for B.Sc. (Honours) in Physiology [Choice Based Credit System]

Semester-V

Course	Course Code	Name of the Subjects	Course Type/ Nature	Teaching Scheme in hour per week			Credit	Marks
				L	T	P		
CC- 11		C11T: Sensory Physiology	Core Course - 11	4	0	0	6	75
		- Lab		0	0	4		
CC- 12		C12T: Endocrinology	Core Course - 12	4	0	0	6	75
		- Lab		0	0	4		
DSE-1		TBD	Discipline Specific Electives -1	4	0	0	6	75
				0	0	4		
DSE-2		TBD	Discipline Specific Electives -2	4	0	0	6	75
				0	0	4		
Semester Total							24	300

L= Lecture, **T**= Tutorial, **P** = Practical, **CC** - Core Course, **TBD** - To be decided, **DSE**: Discipline Specific Elective.

Semester-V

List of Core Course (CC)

CC-11: Sensory Physiology

CC-12: Endocrinology

Discipline Specific Electives (DSE)

DSE-1: Human nutrition and dietetics

Or

DSE-1: Community nutrition and Public health

Or

DSE-1: Clinical Hematology

Or

DSE-1: Biostatistics

DSE-2: Environmental Physiology

Or

DSE-2: Pharmacology & Toxicology

Or

DSE-2: Sports Physiology, Work Physiology and Ergonomics

Or

DSE-2: Ergonomics and Occupational Health

Semester-V
Core Course (CC)

CC-11: Sensory Physiology

Credits 06

C11T: Sensory Physiology

Credits 04

Course Contents:

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

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

Vision: Introduction. Anatomic considerations. The structures of lens. Errors of refraction and their corrections. Contact Lens. Pupillary reflexes, light reflex, near response. Argyll Robertson pupil. Histological details of retina. Photopic and Scotopic vision. The Photoreceptor Mechanism: Genesis of Electrical Responses. Chemical and electrical changes in retina on exposure to light. Visual Pathway and effects of lesion of these path ways. Colour visions and its modern concept. Colour blindness. Other aspects of Visual Function. Visual field, Perimetry. The Image-Forming Mechanism (accommodation and visual acuity) Factors affecting Visual Acuity. Visual acuity and its measurement. Binocular vision and depth perception. Eye Movements. Errors in visual process. Electroretinogram.

Hearing & Equilibrium: Introduction, Sound waves, decibel, Anatomic considerations, structure and functional significance of auditory apparatus – external, middle and internal ears. Structure of Organ of Corti. Hair cells. Mechanism of hearing and its modern theories. Discrimination of sound frequency and loudness. Auditory pathway and centers. Vestibular function. Loss of hearing. Deafness & tests of deafness. Audiometry.

Smell & Taste: Introduction, Smell: Receptors & Pathways - Structure and function of the receptor organs, nerve pathways, centers. Physiology of Olfaction. Olfactometer. Taste: Receptor Organs & Pathways- Structure and functions of the receptor organs, nerve pathways, centers. Physiology of Taste. Features of Taste sensation.

C11P: Histological and Human Experiments

Credits 02

Practical

1. Principles of fixation and staining, staining and identification of fixed nervous tissue.
2. Silver nitrate preparation of corneal cell space.
3. Determination of visual acuity by Snellen's chart / Landolt's C chart.

1. Determination of colour blindness by Ishihara chart.
2. To map the peripheral field of vision with perimeter(Perimetry)
3. Mapping of physiological blind spot and calculation of optic disc size.
4. Recording of auditory and visual reaction time.
4. Exploration of conductive and perceptive deafness by tuning fork method.
5. Audiometry (Demonstration).

CC-12: Endocrinology

Credits 06

C12T: Endocrinology

Credits 04

Course Contents:

General Consideration: Concept of endocrine systems, glands and hormones. Types of endocrine glands. Experimental and clinical methods of study of endocrine glands. General classification of hormones on chemical basis. Concepts of hormone receptors and cell signalling. Mechanisms and Modern Concept of hormone actions: G-protein, Cyclic AMP, cyclic GMP, IP3-DAG, Ca²⁺, Tyrosine Kinase, JAK-STAT pathway and nuclear receptor mediated action. Hypothalamo - hypophysial axis: Feedback regulation, Hypothalamus as a neuroendocrine organ, Releasing Factors, Tropic hormones of hypothalamus. Vascular and neural connections between the hypothalamus and the pituitary, role of median eminence.

The Pituitary Gland: Introduction. Morphology. Histological structures, functions, and regulation of anterior, middle and posterior lobes of pituitary. Posterior pituitary hormones. Growth Hormone: Chemistry, modes of action and functions of growth hormone. Physiology of Growth & factors influencing growth. TSH, ACTH, FSH, LH, Prolactin, MSH, Vasopressin and Oxytocin. Pituitary Insufficiency Pituitary Hyperfunction in Humans. Cushing's disease, gigantism, acromegaly, dwarfism, Simmond's diseases, Frolich's syndrome, diabetes insipidus.

Thyroid Gland: Introduction. Anatomical considerations. Electron microscopic structure of thyroid gland. Thyroid hormone: Chemistry, Biosynthesis, Storage and Transport of thyroid hormones. Effects of thyroid hormones. Functions of T₄ (Thyroxin) and T₃ (Triiodothyronine). Regulation of Thyroid hormone secretion. Clinical feature of Cretinism. Myxedema, Grave's disease. Hashimoto's disease, iodine deficiency goiter.

Hormonal Control of Calcium Metabolism & the Physiology of Bone

Introduction, Calcium & Phosphate Metabolism, Bone Physiology, Vitamin D & the Hydroxy cholecalciferols. Parathyroid Gland: Histological Structure, Parathyroid hormone: Role in calcium metabolism. Relation of parathyroid hormone with bone formation and bone resorption, fragile bone and aging process, Concept of Vitamin D₃ treatment. Calcitonin: its source, functions and regulation. Hormonal control of calcium homeostasis. Effects of Other Hormones & Humoral Agents on Calcium Metabolism

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

Pancreas: Introduction. Histological structure of pancreatic islets Cell. Structure, Biosynthesis & secretion of Insulin. Sources, modes of action and functions of insulin. Insulin Excess. Regulation of Insulin Secretion. Glucagon. Other Islets Cell Hormones. Hypoglycemia & Diabetes Mellitus in Humans.

The Adrenal Medulla & Adrenal Cortex:

Introduction. Adrenal Cortex: histological structure. Structure & Biosynthesis of Adrenocortical Hormones. Regulation different types of hormones and functions of adrenal cortex, Effects of Adrenal androgens & estrogens. Physiologic effects of glucocorticoids. Pharmacologic & Pathologic effects of Glucocorticoids. Regulation of glucocorticoid secretion. Effects of Mineralocorticoids Regulation of aldosterone secretion. Cushing's syndrome, Addison's disease, Hyperaldosteronism. Adrenal Medulla: Histological structure, hormonal function of adrenal medulla. Synthesis and metabolism of catecholamine hormones. Regulation of adrenal Medullary secretion. Actions of adrenaline and nor-adrenaline on different organs and their effect. Pheochromocytoma. Summary of the effects of Adrenocortical Hyper & Hypofunction in humans

Endocrine Functions of the Kidneys, Heart, & Pineal Gland

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

Pineal Gland - Histological structure. Chemical nature, biosynthesis, molecular mechanism of action, functions and regulation of secretion of melatonin.

C12P: Endocrinology (Lab)

Credits 02

1. Fixation, staining and identification of endocrine glands.
2. Study of the effects of oxytocin on uterine contraction of albino rat.
3. Study of the effects of adrenaline on uterine movements of albino rat.
4. Estimation of estrogen by spectrophotometric method.
5. Estimation of plasma level of any hormone using ELISA (Demonstration)

Discipline Specific Electives (DSE)

DSE-1: Human nutrition and dietetics

Credits 06

DSE1T: Human nutrition and dietetics

Credits 04

Course Contents:

Basic concept: Nutrition, Nutrients, Nutraceutical, Cosmoceutical, Nutrigenomics. Constituents of food and their significance. Composition and nutritional value of common food stuffs. Calorific value of foods. Dietary requirements of carbohydrate, protein, lipid and other nutrients.

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

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

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

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

Dietary fibers: Concepts and physiological significance.

Energy in human nutrition: Basic concept of energy and units, calorific and physiological fuel value, Body calorie requirements – adult consumption unit. Respiratory quotient (RQ), Total energy expenditure (TEE), Basal metabolic rate (BMR) and Resting energy expenditure (REE), Specific dynamic action (SDA), physical activity ratio (PAR), Determination of BMR by Benedict Roth apparatus and WHO/ICMR prediction equation, Factors affecting BMR, adult consumption unit (ACU), determination of energy requirements of Indians in different age groups by doubly labeled water (DLW) method and prediction equation method.

Physiology of starvation and obesity.

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

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

DSE1P: Human Nutrition and Dietetics (Lab)

Credits 02

a. Food analysis:

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

b. Identification of food adulterants:

Starch from milk, dalda from butter, saw dust and colouring agents from spices, saccharine in sugar.

c. Planning and preparation of therapeutic diets :

Planning and preparation of therapeutic diets for the following diseases: Hypertension, Obesity, Anemia, Diabetes mellitus, Hepatitis , Gastrointestinal diseases.

d. Diet survey (Field study record):

1. Diet survey report (hand-written) of a family (as per ICMR specification) (Steps- Introduction, Diet History, Methodology, Diet Survey, Clinical Examinations, Remarks, Recommendation and Conclusion) : Each student has to submit a report on his/her own family.
2. A report (hand-written) on the basis of field survey from one of the followings:
 - (1). Physiological parameters of human (at least three parameters).
 - (2). Anthropometric measurements on human (at least three parameters).
 - (3). Epidemiological studies on human.

Or

DSE-1: Community nutrition and Public health

Credits 06

DSE1T: Community nutrition and Public health

Credits 04

Course contents:

Population, society, community and community health: concepts. Nutrition - Introduction. Food as source of nutrients, functions of food, definition of nutrition, nutrients & energy. Adequate,

optimum & good nutrition. Malnutrition and under nutrition, over nutrition. Human nutrition-principle, interrelationship between nutrition, health & diseases. Visible symptoms of good health. Nutrition - fitness, athletics & sports.

Food guide - basic food groups. Use of food guide (according to R.D.A.). Use of food in body - digestion, absorption, transport & utilization. ACU- concept.

Balanced diet. Diet Survey – Principles. Composition and nutritional value of common Indian food stuff - rice, wheat, pulses, egg, meat, fish and milk. Dietary fibres - role of fibers in human nutrition. Calorie requirement. Vitamins and minerals. Malnutrition and under nutrition.

Principles of formulation of balanced diets for growing child, adult man and woman, pregnant and lactating woman. Diet management of obese, diabetic, hypertensive person and athlete. Basic idea on PCM, marasmus, kwashiorkor and their prevention. Iron and iodine deficiency. Recommended dietary allowances, malnutrition and chronic energy, LBW, PEM, xerophthalmia, micronutrient disorders. Physiology of starvation and obesity. Food toxicity. Effect of processing on nutritive values of foods.

Socioecology of nutrition, habitual diets in India and their adequacy. Nutritional assessment of human and community. Malnutrition in a community. National nutrition related health program.

Epidemiology : Concepts. Public health and public health issues: Basic ideas. Etiology, epidemiology and prevention of malaria, dengue, filaria, hepatitis, AIDS, nutritional anemia, atherosclerotic disorders. Causes and management of thalassemia, gout, obesity, endemic goiter, dental carries.

Population problem – principles and methods of family planning and assisted reproductive technology. Sound pollution as a community health issue; definition, concept of noise, source of extraordinary sound, effects of sound pollution on human health, noise index (noise standards).

DSE1P: Practical

Credits 02

Practical:

1. Quantitative estimation of glucose, sucrose by Benedict's method.
2. Estimation of lactose from milk by Benedict's methods.
3. Estimation of Chloride by Mohr's methods.
4. Estimation of amino nitrogen through formol titration methods.
5. Qualitative analysis of pulse, rice, milk to test the presence of carbohydrates, protein, fat.
6. Qualitative identification of lipids and cholesterol.
7. Qualitative assessment of noise by sound level meter.

Field Survey Report:

1. Survey on the status of dietary intake in the surrounding area through visits, etc.
2. Diet survey report of a family (as per ICMR specification). Each student has to submit a report on his/her own family. [Report should be as per ICMR specification. Report should be hand written].
3. A report (hand-written) on the basis of field survey from one of the followings:
 - (1) Physiological parameters of human (at least three parameters).
 - (2) Anthropometric measurements on human (at least three parameters).

Or

DSE-1: Clinical Hematology

Credits 06

DSE-1T: Clinical Hematology

Credits 04

Course Contents:

Anemia and its classification. Laboratory investigation and management of anemia. Iron deficiency anemia, megaloblastic anemia, pernicious anemia- pathogenesis and laboratory investigation. Reticulocytes. Aplastic anemia- laboratory diagnosis. Bone marrow examination. Aspiration techniques.

Hemoglobin - abnormal hemoglobin. Hemolytic anemia and its laboratory investigation. Haemoglobinopathies. Hemoglobin electrophoresis. Sickle cell anemia , Thalassemia- laboratory diagnosis.

Blast cell. Causes and significances of leucocytosis, leucopenia, neutrophilia, eosinophilia, basophilia, monocytosis, lymphocytosis, neutropenia, lymphopenia. Toxic granulation. Leukemia and its classification. HIV on blood cell parameters. LE cells and its significances. Blood parasites.

Hemostasis and Coagulation: Platelet development. Qualitative and quantitative disorders of platelets. Secondary hemostasis. Hemophilia, Willebrand diseases. Disorder of fibrinogen. Fibrinolysis. Bleeding and coagulation disorders.

Blood groups: Immunological basis of identification of ABO and RH blood groups. Biochemical basis of ABO system and Bombay phenotyping. Others blood groups : Kell, Kidd, Duffy, etc. Blood transfusion. Blood banking.

Definition determination and significance of TC, DC ,ESR, Arnth count, PCV, MCV, MHC, MCHC. bleeding time, clotting time, prothrombin time.

DSE 1P: Practical

Credits 02

1. General blood picture

2. Differential Leucocyte Count. Absolute leucocyte count
3. Determination of haemoglobin by various methods.
4. Determination of total RBC count and WBC count.
5. Determination of PCV
6. Determination of red cell indices
7. Determination of ESR.
8. Determination of reticulocyte count.
9. Staining of bone marrow
10. Determination of blood groups.
11. Determination of toxic granulation of neutrophil
12. Determination of total platelet count.
13. Demonstration of thrombin time.(**Demonstration**)
14. Perform sickling test (**Demonstration**)
15. Perform Heinz bodies(**Demonstration**)
16. Demonstration of leukemic slides (**Demonstration**).
17. Determine fibrinogen conc.(**Demonstration**)
18. Demonstrate malarial slide(**Demonstration**)
19. Haemoglobin electrophoresis(**Demonstration**).

Or

DSE-1: Biostatistics

Credits 06

DSE1T: Biostatistics

Credits 04

Course Contents:

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

DSE1P: Biostatistics (Practical)

Credits 02

Practical:

1. 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.

2. Graphical representation of data in frequency polygon and histogram.
3. Student's t test for significance of difference between means.
4. Demonstration: Statistical analysis and graphical representation of biological data with computer application program one way ANOVA .

DSE-2: Environmental Physiology

Credits 06

DSE2T: Environmental Physiology

Credits 04

Course Contents:

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, concept of ozone hole, 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. Mountain sickness. Acclimatization to high altitudes. Preventive measure for hypobaric and hyperbaric effects. Physiological effects and preventive measures against G force, noise, vibration and radiation. Types of pollutants (Primary, secondary and tertiary).

Environment and human health: 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. Vector borne epidemic diseases: Malaria and Plague- etiology and control. Environmental Pollution and Health Hazards: Air Pollution: Definition, sources, air pollutants, effects of air pollution on human health, Water Pollution: Definition, types, health hazards, water pollutants, biological oxygen demand (BOD), thermal pollution, concept of safe drinking water standards. Soil Pollution: causes, health hazards, solid waste management - bioremediation, phytoremediation. Sound pollution: Definition, concept of noise, source of sound pollution, effects of sound pollution on human health, noise index (noise standards). Radionuclide Pollution: ionizing radiations, effects of ionizing radiation on human health, permissible doses. Arsenic Pollution: sources, sources of arsenic in ground water, drinking water standard for arsenic (WHO, USEPA), health effects of chronic arsenic poisoning. Climate change, health impact.

Environmental management: Environmental ethics. Conservation of topsoil, ground water and wild lives; rain water harvesting; sanctuary, national park, biosphere reserve, wildlife (conservation) Act, 1992.

Toxicology: Toxins and Toxicology. Factors Affecting toxicity. LD₅₀, LOD₅₀, ED₅₀, NOEL, LOEL. Concept of acute and chronic Effects. Birth defects and teratogens. Concepts of bio-magnification and bio-concentration. Popular food additives and Food adulterants. Prevention of food adulteration Act, 1954. Other food toxicants: BPA, BPS, Pesticides, PAH, Dioxin, PCB, Heavy Metals: Pb, Hg, Cd, As etc.

DSE2P: Environmental Physiology

Credits 02

Practical:

A:

1. Determination of O₂, CO₂, BOD & COD.
2. Determination of total alkalinity and chlorine in water.
3. Determination of dissolve oxygen in the supplied water samples-supplied water, ground water extracted by shallow and deep tube wells, stream waters, pond water etc.
4. Detection of food additives in different food samples.
5. Biochemical estimation of serum glucose, total proteins, SGPT and SGOT
6. Measurement of environmental temperature – dry bulb and wet bulb, relative humidity, air velocity.
7. Determination of light intensity (at library, laboratory, and class room) by lux meter.
8. Determination of sound levels by sound level meter and noise index.

B: Physiological (experimental) Experiments

1. Kymographic recording of the effects of Hg, Pb , As compounds and food additives on the movements of perfused heart of toad.
2. Kymographic recording of the effects of Hg, Pb , As compounds and food additives on the intestinal movements of rats in Dale's bath.

C: Histo-chemical Experiments

Histochemical studies: chronic effects of food additives and arsenic compounds on liver, kidney, intestine, brain, muscle and lung tissues in rat.

Or

DSE-2: Pharmacology & Toxicology

Credits 06

DSE2T: Pharmacology & Toxicology

Credits 02

Course Contents:

1. **Pharmacology: General Pharmacology:** The importance of pharmacology in the study of physiological processes. Definition of drug, agonist and antagonist.. Nature and source of drugs, routes of drug administration and their advantages, receptor and receptor subtypes. Drug-receptor

interaction, desensitization of receptors. Drug delivery. **Pharmacokinetics:** Drug absorption, distribution, metabolism, and excretion, bioavailability, first pass metabolism, excretion and kinetics of elimination, Biological half life of drug and its significance, Drug-drug interactions. **Pharmacodynamics:** Beneficial versus toxic effects of drugs. Principles and mechanism of drug action, factors affecting drug action. Drug biotransformation. Bioavailability. Drug accumulation. Dose – Response Curve. Adverse drug reaction. Gene therapy.

General considerations, pharmacological classification, mechanism of action and uses of following classes of drugs acting on various systems.

Drugs acting on nervous system: a) General anaesthetics (Nitric oxide, halothane), b) sedative and hypnotic drugs (Phenobarbitone, diazepam), c) Opioid analgesics (Morphine), d) CNS stimulants (strychnine, amphetamine). Neuromuscular blockers : Tubocurarine and succinyl choline. E) 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.

Autacoids & chemotherapy of microbial diseases: Brief introduction to autacoids : drug therapy of inflammation, NSAID and other drugs (aspirin, celecoxib). Chemotherapy of microbial diseases: Antibacterial (sulfonamides), antifungal (amphotericin B).

Hormones and hormone antagonists: Insulin and oral hypoglycaemic agents (tolbutamide, rosiglitazone), thyroid and anti-thyroid drugs (eltroxin, carbimazole), estrogen and progestins (progesterone, hydroxyprogesterone caproate).

Diuretics - Carbonic anhydrase inhibitor, loop diuretic, potassium sparing and osmotic diuretics.

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

2. **Toxicology:** **a. Introduction:** Brief history, Different areas of modern toxicology, classification of toxic substances. Toxins and toxicology. Factors affecting toxicity. **b. Toxic agents, toxic exposure and response:** Toxic agents: Human exposure, mechanism of action and resultant toxicities of the following xenobiotics: Metals: lead, arsenic, Pesticides: organophosphates, carbamates, organochlorine, bipyridyl compounds and anticoagulant pesticides. Toxic exposure and response: Effect of duration, frequency, route and site of exposure of xenobiotics on its toxicity. Characteristic and types of toxic response. Interactions between two and more xenobiotics exposure in humans. Tolerance and addiction. **c. Eco-toxicology:** Brief introduction to avian and aquatic toxicology, movements and effects of toxic compounds in food chain (DDT, mercury), bioaccumulation, biomagnification, acid rain and its effect on ecosystems, concept of BOD and COD. **d. Mechanism of toxicity & evaluation of toxicity:** Mechanism of toxicity: Delivery of the toxicant, mechanisms involved in formation of ultimate toxicant, detoxification of ultimate toxicant. Evaluation of toxicity: various types of dose response relationships, LD₅₀, LC₅₀, LOD₅₀, ED₅₀, NOEL, LOEL, TD₅₀ and therapeutic index. **e. Fate of xenobiotics in human body:** Absorption, distribution, excretion and metabolism of xenobiotics (biotransformation, Phase- I reactions including oxidations, hydrolysis, reductions and phase II conjugation reactions). Toxic insult to liver, its susceptibility to toxicants with reference to any two hepatotoxicants.

3. **Clinical toxicology:** Management of poisoned patients, clinical methods to decrease absorption and enhance excretion of toxicants from the body use of antidotes.

DSE2P: Pharmacology & Toxicology

Credits 02

Pharmacology

1. Handling of laboratory animals. Routes of drug administration (Oral, I.M.)
2. To study the presence of acetaminophen/ aspirin in given sample.
3. Effect of analgesic (Tail-flick test).
4. Pharmacodynamics: dose- response curve.
5. Kymographic recording of the effects of atropine and propranolol on the perfused heart of toad.
6. Setting of organ bath and kymograph. To record the effects of acetylcholine using guinea pig ileum / rat intestine.
7. Anti-anxiety effect of valium (Plus maze test) (**Demonstration**)
8. To study the stages of general anesthesia (**Demonstration**).
9. To determine partition coefficient of general anesthetics (**Demonstration**).
10. Study of competitive antagonism using acetylcholine and atropine (**Demonstration**).

Toxicology

1. Determination of Dissolved Oxygen (DO) using Winkler's method.
2. Determination of Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of water.
3. To perform quantitative estimation of residual chlorine in water samples.
4. To determine the total hardness of water by complexo-metric method using EDTA.
5. To determine acid value of the given oil sample.
6. Calculation of LD₅₀ value of an insecticide from the data provided.
7. Separation of a mixture of benzoic acid, beta- naphthol and naphthelene by solvent extraction and identification of their functional Groups (**Demonstration**).
8. To estimate formaldehyde content of given sample (**Demonstration**).

Suggested Readings:

1. Essentials of Medical Pharmacology, 7th edition (2010), K.D. Tripathi, Jaypee Brothers,
2. Pharmacology, 7th edition (2011), H.P. Rang, M.M. Dale, J.M. Ritter and P.K. Moore, Churchill Livingstone.
3. Hand book of Experimental Pharmacology, 4th edition (2012), S.K. Kulkarni, Vallabh Prakashan, 2012.
4. Cassarett and Doull's "Essentials of Toxicology" 2nd edition (2010), Klaassen and Whatkins, McGraw Hill Publisher.
5. Introduction to Toxicology, 3rd edition (2001), John Timbrell, Taylor and Francis Publishers.
6. Principles of Toxicology, 2nd edition (2006), Stine Karen and Thomas M Brown, CRC press.

Or

DSE -2: Sports Physiology, Work Physiology and Ergonomics

Credits 06

Course Contents:

Sports & work Physiology: Concepts of physical work and physiological work. Physical work: Definition and units of measurement. Classification of physical work. Classification of workloads. Differences between work and sports. Energetic of muscular works. Measurement of energy cost for various physical work. Cardiovascular and respiratory changes during graded exercise. Aerobic and anaerobic capacity. Maximum aerobic power.

Exercise Physiology. Exercise & Performance. Exercise Physiology & Gender. Environmental Exercise Physiology. Maximal oxygen consumption and post exercise oxygen consumption – definition, factors affecting, measurement and significance. Muscle fatigue and recovery. Tests for Physical work capacity – measurement with Bicycle Ergometer, Tread Mill and Harvard Step Test. Work rest cycle and importance of rest pause.

Physical Training: General principles and different methods. Effects of overtraining and detraining. Nutrition in sports – nutrient and caloric requirements for different kinds of sports. Sports injury and its management. Sports rehabilitation and sports medicine. Role of sports in emotion and social factors. Basic concepts of sports psychology. Sports Biochemistry. Ergogenic aids. Ergogenic aids & Dietary supplement.

Ergonomics – Basic concepts and its application in industry to improve efficiency. Ergonomics-importance of ergonomics in occupational health and well beings. Physical work environment. Occupational hazards- Physical, biochemical hazards. Occupational diseases – Silicosis, Asbestosis, Farmer’s Lung. Industrial safety.

Anthropometry : Anthropometry and its implication in general. Different body dimension measures in anthropometry and their significances. Sports Anthropometry.

DSE2P: Practical**Credits 02**

1. Measurements of resting and working heart rate using thirty beats and ten beats methods respectively.
2. Measurement of blood pressure before and after different graded exercise.
3. Determination of Physical Fitness Index (PFI) of an individual and recording of recovery heart rate after standard exercise.
4. Determination of cardiac cost of specific work.
5. Determination of $VO_{2\max}$ by Queens College step test.
6. Determination of endurance time by hand grip dynamometer..
7. Six minutes walk tests.
8. Measurement of some common anthropometric parameters – stature, weight, eye height(standing), shoulder height, sitting height, knee height (sitting), arm reach from wall, mid upper arm circumference, waist

circumference, hip circumference, neck circumference, head circumference, chest circumference.

9. Determination of body surface area (using a nomogram) and Body Mass Index (BMI) for an anthropometric measurement.
10. Measurement of body fat percentage.

Or

DSE-2: Ergonomics and Occupational Health

Credits 06

DSE2T: Ergonomics and Occupational Health

Credits 04

Course Contents:

Ergonomics: Genesis and concept of ergonomics, significance and growth. Importance of ergonomics in occupational health and well being. Application of ergonomics in design and work efficiency. Human machine interaction- concepts, fundamentals of human computer interaction, fundamental idea of display and control. The bio-mechanism of work as related to the user, the work and the environment. Classification of physiological work load. Concept of work rest cycle.

Work environment – Work place components, functional design and arrangements of workplaces, work study, indices of indoor comfort – ventilation, lighting, temperature, noise. Work place stressors and work place risk factors.

Physical work environment: (a) Thermal environment, its' effects, Heat stress indices, (b) Noise and vibration, it's effects on workers. Occupational deafness, (c) Illumination level and it's effect on visual performances, (d) Ergonomic principles of control of physical hazards.

Ergonomic principles of reducing work place stressors and improving work efficiency

Anthropometry and ergonomics: Definition , terminology used in anthropometry. Different body dimensions measured in anthropometry. Anthropometric measurements and its applications in interior designing for different work areas and workers. Concept of percentile and its calculation, and use of percentile values in anthropometry. Static anthropometry, applications of anthropometric data in design. User interface and control display compatibility. Components of worker input – affective, cognitive, temporal and physical (Physical, Physiological, Psycho – physiological aspects of work).

Occupational Health: Concept. The occupational medical history, workers compensations, disability prevention and management. Occupational health risk. Occupational Injury: Musculoskeletal injury, peripheral nervous injury, eye injuries, facial injuries, hearing loss, injury caused by physical hazards, Ergonomics and the prevention of occupational injuries. Occupational exposures: Metals, chemicals, solvents, gasses & airborne toxicants, pesticides. Occupational illness: Brief idea on : Clinical toxicology & immunology, cardiovascular toxicology, liver, renal & neurotoxicology. Occupational hematology, infection, skin disorders & lung disease. Reproductive toxicology. Occupational Diseases: Human diseases associated with occupational exposure. Brief idea on pneumoconiosis, asbestosis, silicosis, farmer's lung and work-related musculoskeletal disorders.

Program management: Occupational stress, substances abuse & employee assistance programs. Occupational safety, industrial hygiene, biological monitoring. Prevention of accidents. Concept of industrial safety.

DSE2P: Ergonomics and Occupational Health

Credits 02

1. Measurement of working heart rate by ten beats methods.
2. Determination cardiac cost of specific work.
3. Measurement of blood pressure before and after different grades of exercise.
4. Measurement of some common anthropometric parameters. Calculation of BSA and BMI from anthropometric data.
5. Measurement of WBGT indices.
6. Measurement of noise level by noise level meter.
7. Assessment of illumination.
8. Determination of strength by hand grip dynamometer.

Vidyasagar University

Curriculum for B. Sc. (Honours) in Physiology [Choice Based Credit System]

Semester-VI

Course	Course Code	Name of the Subjects	Course Type/ Nature	Teaching Scheme in hour per week			Credit	Marks
				L	T	P		
CC- 13		C13T: Reproductive Physiology, Embryology and Chronobiology	Core Course- 13	4	0	0	6	75
		- Lab		0	0	4		
CC- 14		C14T: Renal Physiology, Skin and Body Temperature Regulation, Biomedical Instrumentation	Core Course- 14	4	0	0	6	75
		- Lab		0	0	4		
DSE-3		TBD	Discipline Specific Elective - 3	4	0	0	6	75
				0	0	4		
DSE-4		TBD	Discipline Specific Elective - 4	4	0	0	6	75
				0	0	4		
Semester Total							24	300

L= Lecture, T= Tutorial, P = Practical, CC - Core Course, TBD - To be decided, DSE: Discipline Specific Elective.

Semester-VI

List of Core Course (CC)

CC-13: Reproductive Physiology, Embryology and Chronobiology

**CC-14: Renal Physiology, Skin and Body Temperature Regulation,
Biomedical Instrumentation.**

Discipline Specific Electives (DSE)

DSE-3: Medical Biochemistry

Or

DSE-3: Microbiology and Biotechnology

Or

DSE-3: Medical Microbiology and Immunology

Or

DSE-3: Genetics, Molecular Biology and Bioinformatics

DSE-4: Cognitive Science

Or

DSE-4: Community Medicine, Epidemiological Data Analysis

Or

DSE-4: Patho -Physiological logical Basis of Diseases

Or

DSE-4: Research methodology and Design

Semester-VI
Core Course (CC)

CC-13: Reproductive Physiology, Embryology and Chronobiology Credits 06

C13T: Reproductive Physiology, Embryology and Chronobiology

Credits 04

Course Contents:

Reproductive Physiology:

Reproductive physiology - introduction. Sex Differentiation & Development - Chromosomal Sex. Reproductive genetics. Aberrant Sexual Differentiation. Phenotypic sex differentiation. Gonadal development in the embryo. Pituitary Gonadotropins & Prolactin. Puberty in boys and girls and its control, onset of puberty. Secondary sexual characters, Human sexual response. Menopause.

The Male Reproductive System- Gross anatomy and microscopical anatomy of the male reproductive tract. Histoarchitecture of male reproductive system, testis , seminiferous tubules and interstitial cells of Leydig. Male Reproductive Physiology : gametogenesis - spermatogenesis, spermiogenesis & epididymal function, sperm maturation and ejaculation. Endocrine function of the testes. Control of testicular function, prostate and seminal vesicle. Abnormalities of testicular function.

The Female Reproductive system- Gross anatomy and microscopical anatomy of the female reproductive tract. Histological structure of ovary, Graafian follicle and Corpus luteum, Formation and maturation of ovum. Ovarian Hormones - Chemical nature and function. Steriodogenesis. Control of ovarian function. Physiological mechanism and control of ovulation. Abnormalities of ovarian function. Reproductive cycles: Menstrual Cycle – duration, description and hormonal control, Estrous cycle.

Pregnancy: Transport of ovum and sperm in female reproductive tract. Fertilization and the establishment of pregnancy. Hormones in pregnancy. Placenta - formation, structure, functions and fate of placenta. Placental hormones. Maternal adaptation to pregnancy : changes during pregnancy and its hormonal control. Pregnancy diagnosis : Pregnancy tests (immunological). Foeto-maternal relationship, faeto-placental unit. Ectopic pregnancy. Labour . Parturition: mechanisms and hormonal regulation.

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

Reproductive Health - Physiological concepts for a planned family. Demographic terminology of family planning. Infertility in male and female: causes, diagnosis and management. Assisted Reproductive Technology (ART): sex selection, sperm banks, frozen embryos, in vitro fertilization. Contraception- Concepts, methods, Process, modern contraceptive technologies. Stem cell biology- concept, characterization and application. Exfoliative cytology on gynecological smear –Use of exfoliative cytology on gynecological screening, sample type, fixation & staining, normal constituents, cytology of menstrual cycle, hormonal assessment of smear, inflammatory changes of smear, malignancy.

Reproductive Genetics, Human Genetics and Human Reproductive Disorders: Reproductive Genetics, Human Genetics: Principle of molecular genetics: Gene expression, Gene Structures. Medical genetics: General concepts, Genetic diseases, Population genetics, Pharmacogenetics and pharmacogenomics. Human Genetic Architecture and diseases - Human genetic architecture. Genes and Human diseases. Mendelian disorders. Complex multigenic disorders. Chromosomal disorders: Normal karyotype – concept, significance, techniques-staining, banding, FISH. Structural abnormalities of chromosomes, Cytogenetic disorders involving autosomes and sex chromosomes. Single gene disorders with non-classic inheritance. Mosaicism. Molecular diagnosis of genetic diseases.

Human reproductive disorders: Abnormalities of male and female sexual differentiation and development. Puberty: Precocious, delayed or absent puberty, Amenorrhoea: Primary and Secondary. Hyper-prolactinaemia, Sexual dysfunction, infertility, Pregnancy: multifoetal pregnancy and spontaneous pregnancy loss, Pre- eclampsia, eclampsia, endometriosis. Basic concepts of ovarian cysts. Genetic imprinting and reproductive tumors.

Embryology:

Cleavage: cleavage plane, types, role of yolk in cleavage; cleavage process in mammals. Embryogenesis, morula, blastula, gastrula and blastocyst. Formation of trilaminar germ disc. Gastrulation, organogenesis. Development of alimentary system, heart and urogenital system. Development of eye as an example of reciprocal and repeated inductive events. Foetal circulation and its changes after birth.

Chronobiology:

Introduction to Chronobiology. Historical developments in chronobiology; Biological oscillation: the concept of average, amplitude, phase and period.

Biological Rhythm – Definition, terminology of biorhythm, significance. Types and characteristics of biological rhythms: Short- and Long- term rhythms; Circadian rhythms; Tidal rhythms and Lunar rhythms. Circannual rhythms; Photoperiod and regulation of seasonal reproduction of vertebrates. Different types of physiological rhythms - ultradian, circadian, infradian. Circadian rhythms - concepts, types, explanation and experimental evidences.

Concept of synchronization and masking; Photic and non-photic zeitgebers. Importance of environmental synchronization (Zeitgeber or Synchronizer) on Circadian rhythms. Different

zeitgebers and their relation with circadian rhythm. Circadian rhythms in human. Biorhythms of LH, FSH, Prolactin, Estrogen, Progesterone, ACTH, GH, Cortisol. Light dark cycle and regulation of penial hormone.

Biological clock, physiological clock: Concepts, biological clock and environmental changes, classification and function of biological clock. Location and origin of biological clock. Fundamental nature of biological clock. Mechanism of biological clock. Master clock or central clock – types, location and mechanisms. Neural basis of biological clock and the role of suprachiasmatic nuclei. Adaptive significance of biological clocks. Sleep – wakefulness cycle. Body temperature rhythm. Time keeping Genes. Brief idea of jet-lag and shift work. Chronobiology in health. Biological clock and medicine.

C13P: Reproductive Physiology, Embryology and Chronobiology (Practical) Credits 02

List of Practical:

1. Study of estrous cycle.
2. Tissue fixation, embedding in paraffin, microtomy, slide preparation and identification of uterus, testis, ovary.
3. Examination of histological sections of permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive system; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.
4. Pregnancy test from human urine by kit method.
5. Sperm count, sperm motility test in rat. Sperm viability test by using eosin - Y.
6. Determination of diurnal and/or circalunar rhythm of body temperature of college going students.
7. Study of circadian functions in humans (daily eating, sleep and temperature patterns).
8. Project work on assessment of individual differences in human circadian rhythms (chronotype in human population) by questionnaire method among school children and college students.

Demonstration:

1. Surgical techniques: Principles of surgery in endocrinology and Reproductive Physiology.
2. Ovariectomy, Hysterectomy, Castration and Vasectomy in rats.
3. Human vaginal exfoliate cytology.

CC-14: Renal Physiology, Skin and Body Temperature Regulation, Biomedical Instrumentation Credits 06

C14T: Renal Physiology, Skin and Body Temperature Regulation, Biomedical Instrumentation Credits 04

Course Content:

Renal Physiology:

Renal Physiology- introduction. Gross structure of kidney. Microanatomy (including electron microscopy) of a nephron and structural differences between cortical and juxtamedullary nephrons. Juxtaglomerular apparatus. Function of Malpighian corpuscle and renal tubule. Renal circulation-peculiarities and autoregulation.

Mechanism of urine formation: Concept of ultrafiltration, glomerular filtration rate, reabsorption by passive and active tubular transport. Concept of counter current system, counter-current mechanism countercurrent multiplier, exchanger and mechanism of concentrated urine formation. Water excretion, acidification of the urine & bicarbonate excretion. Regulation of Na^+ & Cl^- excretion. Non-excretory function of kidney. Constituents of urine - normal and abnormal constituents of urine and their clinical significance. Concept of renal threshold. Renal Function Tests. Renal stone formation. Dialysis and artificial kidney. Diuretics. Disorders of Renal Functions.

Physiology of Urinary bladder, urine storage and micturation. Innervations of urinary bladder. Filling of the Bladder and emptying of the bladder. Micturition reflexes and its regulation by higher centers.

Skin and Body Temperature Regulation:

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

Normal body temperature. Channels of heat loss and heat gain process. Regulation of body temperature in homeotherms : physical and physiological processes, roles of neural and hormonal processes, higher centers and mechanism of regulation.

Pyrexia, Hypothermia and hyperthermia, physiological basis of fever. Cold stress. Insulating effects. Acclimatization to heat and cold.

Biomedical Instrumentation and Techniques:

Biomedical basis of Diseases: Basic concepts, pathogenesis to symptoms and diagnosis of infectious diseases, inherited/genetic diseases; immunological diseases, cancer.

Basics of Biomedical Instrumentation: Development of biomedical instrumentation, components of man-instrument system. Biomedical systems, design factors and limitations of biomedical instruments. Transducer, Biosensors - concept, classification. Bioelectric potentials, Bio potential electrodes – concepts, significance and application .Electric current - physiological effects. Shock hazards, safety. Measurement system and errors.

Medical diagnostic techniques related equipment: Principles of microscopy including Fluorescence microscopy, Atomic Force Microscopy, Transmission and Scanning Electron Microscopy. Flow Cytometry (FACS). Karyotyping – Chromosome banding, FISH. Spectroscopic Techniques - Principle, different types, instrumentation. Histopathology, Histochemistry, Cytogenetics – staining techniques. Chromatography – Principle and application of different chromatography including TLC, GLC, HPLC, Ion-exchange chromatography,

molecular sieve chromatography, affinity chromatography. Electrophoresis - Principle, instrumentation and medical significances of AGE, PAGE, SDS-PAGE. Centrifugation - Principle and physiological significances.

Biomedical instruments – Biomedical instruments and cardiovascular monitoring systems: Basic concepts, instrumentation of Cardiac monitor, ECG, Blood flow meters, Oximeter, equipments for blood pressure, cardiac output and heart sounds. Methods of monitoring fatal heart rate. Cardiac pacemakers, cardiac defibrillators. Clinical Laboratory Instruments: General principle and instrumentation of Blood Gases Analyzer, Auto-analyzer, Blood Cell Counters, ELISA reader, spectrophotometer, flame photometer. Auto analyzer. Biomedical Instruments for Respiratory measurement systems: Basic principles and instrumentation of pneumograph, Spirometer, pneumotachometers, Respiratory therapy equipment, apparatus for anaesthesia. Biomedical Instruments and Nervous system: Concept and basic principles of Psycho-physiological measurement techniques, instruments for measurements of nervous system, motor response, sensory response. EEG. Imaging systems: Basic principles, instrumentation of X-Ray machine, Mammography, X-ray computed tomography (CT Scanner) and computer-aided tomography (CAT), Fluoroscopy. Ultrasound Imaging - Ultrasonic imaging system. Echocardiography, Doppler effects, three dimensional ultrasound. Radioactivity : Radiation, Radio isotopes-concepts, Scintillation counter, Gamma camera & Gamma camera imaging , Radio nucleotide scan, Emission Tomography- ECT Emission Coupled Tomography, SPECT & PET - concept. Magnetic Resonance Imaging- Magnetism and nuclear magnetism, Magnetic Resonance Imaging (MRI) system, MRI Maps of body, Sports medicine, Breast imaging and Brain Mapping. **Optics, Fiber Optics, Diathermy equipment, Audiometer and Laser :** Optics: science of life. Fiber Optics - Endoscopes and Laparoscope - principles and applications. Diathermy: principles, types and biomedical significance. Audiometers: principle and methods. Laser- formation, mechanisms and medical application. Significances. **Application of computer in Biomedical field, Biotelemetry, Physiological modeling-** Computer: basic components, imaging techniques, database, web design, automation for instruments used for clinical laboratory, use of microprocessor in medical instruments, PC- based medical instruments, computerized critical care unit. Biotelemetry: concepts, components, application. Physiological modeling: biological modeling - modeling process, methods, equation. Deterministic & stochastic model. Compartmental model- concept. Physiological modeling software.

C14P: Renal Physiology, Skin and Body Temperature Regulation, Biomedical Instrumentation (Practical)

Credits 02

List of Practical:

1. Tissue fixation, embedding in paraffin, microtomy, slide preparation and identification of kidney and ureter.
2. Identification for normal constituents of urine.
3. Identification for abnormal or pathological constituents of urine.
4. Tests for urinary deposits.
5. Detection of specific gravity of urine.

6. Estimation of albumin in urine.
7. Estimation of urea in urine.
8. Estimation of total phosphates in urine.
9. Routine clinical tests of urine.
10. Recording of body temperature.
11. Study the skin to blunt injury (triple response).
12. Measurement of heart sound using electronic stethoscope.

Demonstration

1. SDS – PAGE electrophoresis for protein (**Demonstration**)
2. Physiological data acquisition by ECG, EEG (**Demonstration**)
3. Study of X ray/CT machine (**through demonstration**).
4. Study of mammograms and CT scan images (**Demonstration**).
5. Estimation of sodium and potassium in blood serum or urine sample by using auto analyzer (**Demonstration**).
6. Determination pulmonary function using spirometer (using mechanical system) (**Demonstration**).

Discipline Specific Electives (DSE)

DSE-3: Medical Biochemistry

Credits 06

DSE3T: Medical Biochemistry

Credits 04

Course Contents:

Unit-I: Basic Concepts and scope. Clinical Biochemistry - Organization of clinical laboratory, Introduction to instrumentation and automation in clinical biochemistry laboratories safety regulations and first aid. General comments on specimen collection, types of specimen for biochemical analysis. Precision, accuracy, quality control, precautions and limitations.

Unit-II: Evaluation of biochemical changes in diseases: Basic hepatic, renal and cardiovascular physiology. Biochemical symptoms associated with disease and their evaluation. Diagnostic biochemical profile. Pathophysiological significances of glucose, serum protein, albumin, urea, creatinine, uric acids, ketone bodies.

Unit- III: Enzymes: Distribution and diagnostic significance- Properties of enzymes used in diagnosis of metabolic disorders, clinical significance of diagnostically important enzymes: creatine kinase, lactate dehydrogenase, alanine and aspartate aminotransferases, amylase, acid and alkaline phosphatase, beta glucuronidase, with a detailed account of the biochemical

reactions catalysed by these enzymes and of their clinical assays; kinetic assay and end point assay for the enzymes. A detailed account on isoenzymes, their tissue distribution and clinical significance.

Unit -IV: Hormones: Classification with reference to their biochemical nature, mechanism of action (one example from each class of hormones), Function. Pathophysiology of disorders associated with hormones. Biochemical diagnosis of hormonal disorders.

Unit-V: Structural complexities and diseases associated with carbohydrates and lipids:

Carbohydrates: Sugars as information molecules; detailed account on Lectins: their role in physiological functions and their potential as drug targets in various infectious diseases. Dietary fibers. Assessment of glucose metabolism in blood: Clinical significance of variations in blood glucose. Diabetes mellitus. Glycosylated Hb

Lipid profile: Types of Lipoproteins (chylomicrons, VLDL, LDL, HDL); disorders associated with lipoprotein metabolism (hypercholesterolemia, atherosclerosis). Composition and functions of lipoproteins. Clinical significance of elevated lipoprotein. Lipid profile in health and diseases.

Metabolism of ketone bodies in diabetic patients. Prostaglandins- classification, biosynthesis, role of COX-1, COX-2, NSAIDS in synthesis; functions Steroids-Cholesterol- biosynthesis and regulation, inhibitors of cholesterol biosynthesis (Statins-structure and mechanism of action).

Unit -VI: Vitamins: Definition, classification, requirement and recommended allowances, and dietary precursors; diseases due to deficiency of water-soluble and fat-soluble vitamins: the symptoms and the clinical significance. Assay of vitamin.

Unit- VII: An overview of integrative metabolism: Local and global regulation in tissue specific metabolism, interplay of insulin and glucagon integration of various metabolic pathways of proteins, lipids, carbohydrates and nucleic acids, obesity- role of Leptin, Ghrelin and other hormones in regulation of body mass, electron transport chain and inhibitors, oxidative phosphorylation, role of uncouplers and ionophores.

Unit -VIII: Organ Function Tests: **a. Liver function tests:** Structure of the liver, liver function tests, causes of different liver diseases, liver function tests in the diagnosis of liver diseases. Pathophysiological significance of bilirubin. **b. Renal function tests and urine analysis:** Composition of urine. Use of urine strip / dipstick method for urine analysis. Basic ideas on different types of test for renal diseases. **c. Tests for cardiovascular diseases:** Involvement of enzymes in diagnostics of heart disease: aspartate transaminase, isoenzymes of creatine kinase and lactate dehydrogenase and troponin.

DSE3P: Medical Biochemistry (Practical)

Credits 02

List of Practical:

A. Collection of blood and storage. Preparation of serum and plasma from whole blood and storage.

B. Quantitative determination of the following in the whole blood/plasma/serum:

1. Estimation of blood glucose by glucose oxidase peroxides method.
2. Estimation of blood glucose by Nelson – Somogyi method.
3. Estimation of blood inorganic phosphates by Fiske - Subbaraow method.
4. Estimation of serum total protein by Biurate methods and determination of albumin globulin ratio.
5. Estimation of HDL/LDL and Triglycerides.
6. Estimation of bilirubin (direct and indirect).
7. Quantitative determination of serum creatinine, uric acid and urea.
8. Determination of serum amylase by iodometric method.
9. Estimation of creatine kinase.
10. Estimation of SGOT, SGPT, Acid & Alkaline Phosphatase.

Demonstration:

1. Estimation of Lactate dehydrogenase, beta glucuronidase (**Demonstration**).
2. SDS-PAGE Electrophoresis for Protein (**Demonstration**).
3. Five case studies based on above quantitative estimations performed (**Demonstration**).

Or

DSE-3: Microbiology and Biotechnology

Credits 06

DSE3T: Microbiology and Biotechnology

Credits 04

Course Contents:**Microbiology:**

Viruses: structure, types. Lytic and lysogenic cycle. DNA & RNA Viruses. Viroids and Prions. Bacteriophages – structure & morphological classification.

Bacteria: structure, classification. Staining :- Principle , procedure, uses. Gram stain, Acid – fast stain, Albert stain .Biochemical tests for identification Pathogenic and non - pathogenic bacteria.

Nutritional requirements of bacteria, nutritional types culture media. Bacterial Growth curve-preparation, physiological factors required for growth. Bacterial metabolism: fermentation (ethanol, lactic acid, acetic acid), glyoxalate cycle, Entner – Doudoroff pathway,

Phosphoketolase pathway. Bacterial genetics: elementary idea of transformation, conjugation and transduction. Sterilization, disinfection and pasteurization: Physical and chemical methods used. Antibiotics, bacteriostatic & bacteriocidal agents. Bacteriolytic agents. Concepts of

antiseptic, probiotics and prebiotics. Basic idea about medical bacteriology, virology and mycology. Food microbiology – brief ideas about food spoilage (fish, meat, milk, vegetables) and its prevention. Industrial Microbiology: Elementary knowledge for production of fermented

products like alcohol, glutamic acid, penicillin and milk products (cheese, dahi). Environmental Microbiology: Role of microbes in Bio-geo chemical cycle (brief).

Biotechnology: History and importance. DNA and RNA. Gene, Genome and Genetic code, translation. Recombinant DNA technology: concepts, techniques and application., DNA manipulation. Cloning – concept and significances. Cloning vectors. cDNA libraries. DNA sequencing. Basic concepts of Southern, Northern, Western blot techniques and DNA micro array. Polymerase Chain Reaction (PCR). RT-PCR- Basic concepts. Enzyme immobilization: basic concepts. Tissue culture – basic concepts. Human genome projects. Transgenic animals. Hybridoma techniques - Basic concepts. Monoclonal antibody. Protein interaction technology. DNA technology and gene therapy. DNA technology in diseases diagnosis. Genetic Bar-coding. Fermentation technology: Fermentation, types, bioreactors, upstream and downstream processing. Physiology and biotechnology process. Bio-pesticides, bio-plastics, biosensors, biochips: concepts and significances. Bio-safety and intellectual property Rights. Genomics and Proteomics. Bio-safety and ethical issues in biotechnology

DSE3P: Microbiology and Biotechnology (Practical)

Credits 02

List of Practical

1. Study of disinfection and sterilization techniques.
2. Culture procedure and isolation of bacteria.
3. Biochemical characterization of microorganisms (Biochemical tests – Catalase test, Oxidase test, Fermentation of sugar- Glucose, Lactose, Sucrose, Mannitol, Hydrolysis of Starch, Gelatin, Casein, Citrate and Propionate utilization test, Indole production test, Nitrate reduction test, Methyl red test and Voges Proskauer [V. P.] test).
4. Negative staining. Gram staining techniques of bacteria. Acid-fast staining of bacteria. Bacterial spore staining.
5. Isolation of DNA from blood and microbial culture.
6. Separation of DNA by agarose gel electrophoresis. Extraction of DNA from agarose gel. Quantification of DNA.
7. Prepare SDS-PAGE for protein. Gel electrophoresis of protein. Quantification of protein.

Demonstration:

1. Perform immunodiffusion by Ouchterlony methods (**Demonstration**).
2. Analysis of DNA sequences (**Demonstration**).
3. Application of PCR (**Demonstration**).
4. Prepare ELISA (**Demonstration**).
5. Perform Immunoprecipitation (**Demonstration**).

Or

DSE-3: Medical Microbiology and Immunology

Credits 06

DSE3T: Medical Microbiology and Immunology

Credits 04

Course Contents:

Unit-I: Fundamental Concepts:

a) History of microbiology, Discovery of microorganisms, Contributions of Louis Pasteur and Robert Koch in Medical Microbiology. b) Molecular methods of assessing microbial phylogeny- molecular chronometer, phylogenetic trees, rRNA, DNA and proteins as indicator of phylogeny. c) Microbial growth, growth factors, culture media - types of media. Pure Cultures, Growth curves and generation time, Control of microbial growth, general concept of effect of environmental factors on growth of microbes.

Normal microflora of the human body and host pathogen interaction : Normal microflora of the human body, importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection. Bacterial Cells - fine structure and function : Size, shape and arrangement of bacterial cells. Cell membrane, cytoplasmic matrix, inclusion bodies (eg. magnetosomes), nucleoid, ultrastructure of Gram +ve and Gram -ve bacterial cell wall, Pili, Capsule, Flagella and motility. Microbial Genetics. Principles of Diseases and Epidemiology: Relationship between normal microbiota and host, Opportunistic microorganisms. Development and spread of infectious diseases: invasion, pathogen, parasite, pathogenicity, virulence, carriers and their types.

Unit-II: Sample collection, transport and diagnosis: Collection, transport and culturing of clinical samples and their identification characteristics.

Unit-III: Bacterial Diseases (with reference to etiology, clinical symptoms, virulence factors involved, detection and prevention): Respiratory tract infections, Diphtheria and tuberculosis, Gastrointestinal tract infections, staphylococcal food poisoning and *E. coli* gastroenteritis, Urinary tract infections: gonorrhoea and syphilis.

Unit-IV: Viruses, viroids, prions: General characteristics of viruses, structure, isolation, cultivation and identification of viruses, viral multiplication, one step multiplication curve, lytic and lysogenic phages (lambda phage), concept of early and late proteins, clinical virology with reference to HIV virus and hepatitis virus (Life cycle and clinical symptoms), viroids and prions.

Unit-V: Medical Mycology (with reference to life cycle and clinical symptoms) : General and detailed life cycle of *Aspergillus* and *Candida albicans* in relation to human diseases caused by them.

Unit-VI: Parasitology (with reference to life cycle and clinical symptoms): Classification of medically important parasites. Common protozoan disease: Malaria, Infections caused by *Taenia solium* / *Taenia saginata*, *Fasciola hepatica* and *Ascaris lumbricoides*.

Unit-VII : Antimicrobial chemotherapy and emerging antimicrobial resistance: Spectrum of antimicrobial activity, action of antimicrobial drugs, anti-mycobacterial antibiotics, inhibitors of protein synthesis and nucleic acid synthesis, inhibition of cell wall synthesis, inhibitor of cell membrane function, inhibitor of metabolism. Antifungal agents: mechanism of actions of Amphotericin B, Griseofulvin , Antiviral agents :Mechanism of action of Amantadine,

Acyclovir, Azidothymidine. Anti - protozoan drugs; effectiveness of chemotherapeutic agents. Antimicrobial resistance – concepts.

Unit-VIII: Overview of Immune System - properties of immune system; types of immunity: innate immunity, acquired immunity, active and passive immunity. First and second line defence. Antigens and Antibodies: Characteristics of an antigen (foreignness, molecular size and heterogeneity); haptens; epitopes (T & B cell epitopes), Adjuvants : Structure, Types and Functions of antibodies.

Unit-IX: Generation of Immune Response: Primary and secondary immune response; Generation of humoral immune response (Plasma and Memory cells); Generation of cell mediated immune response. Cytokines. Complements.

Unit-X: Immunological Disorders and Tumor Immunity & Immunological Techniques: Types of Autoimmunity and Hypersensitivity with examples; Immunodeficiencies – acquired immune deficiency. Animal models (Nude and SCID mice). Transplantation immunity. Immunological Techniques: Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, ELISPOT.

DSE3P: Medical Microbiology and Immunology (Practical)

Credits 02

List of Practical:

1. Study of composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS
2. Staining methods: Gram staining, Acidfast staining (permanent slide only), Capsule staining and spore staining.
3. Study and plot the growth curve of *E coli* using turbidometric method and to calculate specific growth rate and generation time.
4. Identify bacteria on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests .
5. Study of bacterial flora of skin by swab method.
6. Perform Widal test.
7. Staining and morphological characterization of *Aspergillus sp.*, *Pencillium sp.* and *Saccharomyces sp.*
8. Antibacterial testing by Kirby-Bauer method.
9. Immunodiffusion by Ouchterlony method. Immunodiffusion by Mancini method.
10. Determination of minimal inhibitory concentration (MIC) of an antibiotic.
11. Study of various stages of malarial parasite in RBCs using permanent mounts.
12. Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chicken pox, HPV warts, AIDS (candidiasis), dermatomycoses (ring worms)

Demonstration:

1. Demonstration of PCR based method of detection of any causative gene (**Demonstration**).
2. Isolation of bacteriophages (any with a non-pathogenic host) and calculation of the plaque forming units (pfu) (**Demonstration**).
3. Complement fixation assay (**Demonstration**).
4. Agglutination inhibition assay (**Demonstration**).
5. Sandwich dot ELISA (**Demonstration**).

Or

DSE-3: Genetics, Molecular Biology and Bioinformatics

Credits 06

DSE3T: Genetics, Molecular Biology and Bioinformatics

Credits 04

Course Contents:

Genetics:

Introduction to Genetics: Mendel's work on transmission of traits, Genetic variation, molecular basis of genetic information. Mitosis and Meiosis.

Mendelian Genetics and its Extension: Principles of inheritance, Chromosome theory of inheritance, Laws of probability, Pedigree analysis. Monohybrid and dihybrid, test and back crosses. Incomplete dominance and codominance. Bacterial genetics - transformation, transduction, conjugation (mention of F⁺ /F⁻, Hfr strain, function of pilus). Extension of Mendelism – Multiple alleles, Lethal alleles, Epistasis and its different types present in plants and animals. Penetrance, expressivity, pleiotropism. Environmental effects on phenotypic expression, sex linked inheritance. Linkage, Crossing over and Chromosome mapping. Mutations: Chromosomal mutations, Gene mutation. Detection of mutation: CLB method, Attached X method, DNA repair mechanism. Sex determination and sex linkage, Extrachromosomal inheritance. Quantitative genetics: Quantitative and multifactor inheritance, Transgressive variations, Heteriosis.

Chromosome structure: Concept of nucleosome, molecular organization, chromosomal proteins, the different levels of chromatin organization. Numerical and Structural variations in chromosome - basic concepts of aneuploids and polyploids.

Human Genetics: History of human genetics- Early Greek concepts about inheritance, Cytogenetics history (the works of Winiwater, Painter and Tjio and Levan), Landmark achievements of Galton, Garrod etc. Pedigree analysis. Patterns of inheritance for monogenic traits. Organization of Human Genome : General feature, gene clusters, diversity in size and organization of gene, types of repetitive DNA, pseudogene, gene families, endoreplication and amplification, genetic markers.

Human Cytogenetic – Techniques (karyotyping and FISH), Human Karyotype –banding pattern and nomenclature (G and Q banding), Common syndrome – numerical chromosome changes, structural alterations. Use of human cytogenetics in medical science. Aneuploidy in humans. Chromosome abnormalities and cancer. Mapping strategies : Physical Map , Genetic Map. Techniques for genomics: DNA sequencing, DNA fingerprinting, polymorphism screening, expression analysis and proteomic analysis.

Identification of genetic basis of diseases. Population genetics. Prenatal diagnosis - introduction, significance and methods. Clinical genetics : inborn error of metabolism, genetic basis of colour blindness, familial cancer, infertility and in vitro fertilization, mental retardation. Genetic disorders of Haemopoietic systems.

Implications of Genome Research: Diagnosis and screening of genetic disorders, prenatal genotyping for mutations in β - globin gene and sickle cell anemia, DNA profiling: establishing identity and relationships, applications in personalized medicine (genetic polymorphism in drug metabolism genes e.g. cytP_{450} and GST and their effect on drug metabolism and drug response), genetic counseling.

Molecular Biology:

Nucleic acids convey genetic information. The structure of DNA and RNA, DNA topology, organelle DNA. The Replication of DNA. The Mutability and Repair of DNA. Transcription (Prokaryotes and Eukaryotes). RNA modification. Translation (Prokaryotes and Eukaryotes). Regulatory RNAs. RNA editing. Gene and Genetic code - properties and wobble hypothesis. Gene expression and gene silencing. Methods for analysis of gene expression. Chromosomal aberration and gene mutations (agents and types). Gene Knockout. Protein sequencing methods, detection of post translation modification of proteins. DNA sequencing methods. Molecular markers in genome analysis. Genetic counseling.

Basic idea of Recombinant DNA technology and its applications, Polymerase Chain Reaction (PCR) – concepts, and application in human disease diagnosis.

Concept of oncogenes, tumour suppressor genes and properties of cancer cells. Molecular basis of apoptosis in brief. Gene therapy, transgenic animal. Molecular Techniques: PCR, Western and Southern blot, Northern blot, Sanger DNA sequencing.

Bioinformatics:

Introduction to bioinformatics - Definition, important contributions, task, application, challenge and opportunities. Computer Fundamentals – Programming languages in bioinformatics, Role of Super computer in biology. Historical background. Scope of bioinformatics – Genomics, Proteomics and Computer aided Drug Design (Structure based and ligand based approaches).

Biological databases and data retrieval: Information Network. Database, Tools and uses. Introduction to biological databases – primary, secondary and composite databases, NCBI, nucleic acid databases (GenBank, EMBL,DDBJ,NDB), Protein databases (PIR, Swiss- Prot, TrEMBL, PDB). Nutrient data bases. . Bioinformatic tools- FASTA, BLAST.

DNA sequence analysis. Sequence Alignment. Predictive method using DNA and Protein sequences. Introduction to computational biology- prediction of 3-D protein structure. Identification of unknown protein. Phylogenetic Analysis. Drug design, Discovery and Pharmacoinformatics. Bioinformatics and Health informatics – concepts and application in health and medicine.

DSE3P: Genetics, Molecular Biology and Bioinformatics (Practical) Credits 02

List of Practical:

Genetics:

1. Preparation of human metaphase chromosomes and Giemsa staining.
2. Karyotyping with the help of photographs.
3. Abnormal karyotypes and chromosome aberrations.
4. PTC testing to prove monogenic inheritance.
5. Preparation of pedigree charts of some common characters like Tongue rolling, ear 6 lobes, blood groups, colour blindness.
6. Isolation of DNA from blood and microbial culture.
7. Estimation of DNA using colorimeter by Diphenyl reagent .
8. Estimation of DNA by Spectrophotometer (A 260 measurement). Quantify and analyze the purity of DNA using spectrophotometer (estimating at 260 nm, 280nm and 320nm).
9. Estimation of RNA by Orcinol method.
10. Separation of DNA by agarose gel electrophoresis. Extraction of DNA from agarose gel and quantification of DNA.
11. Determination of melting temperature of DNA.
12. Prepare SDS-PAGE for protein. Gel electrophoresis of protein and quantification of protein.
13. Searching of scientific information using NCBI or any search engine. Webbased analysis: retrieval of a desired human sequence from NCBI database and sequence alignment using BLAST.
14. Three dimension analysis of protein molecules.

Demonstration:

1. Demonstration of DNA fingerprinting (**Demonstration**).
2. Polymorphism analysis using PCR (**Demonstration**).
3. Demonstration of mammalian sex chromatin (**Demonstration**).
4. Demonstration Southern Blotting, Northern Blotting, Western Blotting (**Demonstration**).
5. Analysis of DNA sequences (**Demonstration**).
6. Phylogenetic analysis using PHYLIP (**Demonstration**).
7. Primer designing using software (**Demonstration**).
8. Microarray analysis using Bioconductor (**Demonstration**).

DSE-4: Cognitive Science

Credits 06

DSE4T: Cognitive Science

Credits 04

Course Contents:

Unit-1: Anatomy of brain and spinal cord

Gross anatomy of cerebrum, cerebellum, brain stem and spinal cord. Cranial and spinal nerves. Autonomic nervous system - sympathetic and parasympathetic nervous system. Neurogenesis in developing brain.

Unit-2: Methods of neuroscience

EEG, Event-related potential, CAT, MRI, fMRI, PET, Magnetoencephalography, Optical recording.

Unit-3: Memory and Emotion

Different types of memory. Neural organization of memory. Cellular and molecular basis of memory. Cortical and subcortical contribution to emotion: Fight or Flight response, Reward and motivation, Regulation of emotion, communicating emotion,

Unit-4: Language and speech

Neural basis of speech, Speech disorders. Neural organization of language, language processing. Hemispheric specialization in language and other functions. Split brain. Neural basis of attention and social cognition

Unit-5: Developmental disorders

Cognitive development theory, -piagets and Kohlberg moral reasoning theory, mental retardation, degree of mental retardation, causes of mental retardation, down syndrome, dyslexia, Attention deficit hyperactivity disorder, autism

Unit-6: Cognitive disorders

Cognitive changes with aging. Cognitive disorders: Alzheimer's disease, Frontotemporal dementia, Creutzfeldt Jakob disease, Vascular dementia, Schizophrenia, Depression, Anxiety disorders.

DSE4P: Cognitive Science (Practical)

Credits 02

List of Practical:

1. Primacy and recency in short term memory in human subjects
2. Cognitive assessment by coloured matrices test in children

3. Test to assess the duration of short term memory
4. Psychometric tests for children- Developmental Assessment Scale for Indian Infants (DASII), Wechsler Preschool and Primary Scales of Intelligence (WPPSI), Children Apperception Test (CAT).
5. Animal study: Food retrieval in maze study

Or

DSE-4: Community medicine, Epidemiological Data Analysis

Credits 06

DSE4T: Community medicine, Epidemiological Data Analysis

Credits 04

Course Contents:

Unit-I: Concepts of Health and Disease: Definition of health, determinants of health. Agent, host and environmental factors in health and disease. Multifactorial etiology of disease.

Unit-II: Epidemiology: a. Principle of Epidemiology and Epidemiological methods: Terms used in describing disease transmission and control. Morbidity and mortality indicators. Measurements of epidemiological indicators, Epidemiology study designs. Concept of association, causation and bias. Screening for diseases. **b. Epidemiology of communicable diseases:** Extent of problem, Diagnosis- clinical and laboratory, Treatment and control, Health Programmes. Respiratory infections: measles, rubella, mumps, influenza, diphtheria, whooping cough, tuberculosis. Intestinal infections: poliomyelitis, viral hepatitis, cholera, typhoid, food poisoning, acute diarrheal diseases. Arthropod-borne infections: dengue, malaria, filariasis, leishmaniasis. Zoonosis : rabies, surface infections: leprosy, HIV/AIDS **c. Epidemiology of chronic non-communicable disease and conditions:** Coronary heart disease, cancer, diabetes, hypertension, blindness.

Unit-III: Health & Nutrition and Reproductive & Child Health: a. Health & Nutrition: Concept of Balanced diet - nutritional requirement. Nutrition related disorders- Protein energy Malnutrition, Vitamin A deficiency, Iron deficiency anemia, Iodine deficiency disorders. **b. Reproductive and Child Health:** Child Health, Maternal Health, Immunization, Population Control Measures.

Unit-IV: Environment & Health and Occupational Health: a. Environment & Health Water pollution: Indicators of water pollution, Prevention and Control. Air pollution: Indicators of air pollution, Prevention and Control. **b. Occupational Health:** Basic Concepts (Silicosis and Byssinosis)

Unit-V: Health Care system in India: Health planning, National Health Policy, Primary Health Care, Health Care delivery system in India.

Unit-VI: Medicine and Society: Introduction. Measuring diseases of a society - a. Prevalence. b. Incidence. Detection of causes of diseases and Risk factor - Methods of detection of diseases in a population. Assessing the effectiveness of the treatment of diseases: a. Effectiveness of treatment, b. Cost of therapy, c. Resource required to administer the therapy. The Socio-cultural context of medicine: a. Doctor- Patient's relationship, b. Illness behavior.

Unit -VII: Epidemiological Data, epidemiologic methods and survey: Components of epidemiology: Frequency, distribution and determinants of disease. Epidemiological approach and measurements - vital statistics (rates, ratios and proportions), measurements of health indicators. **Epidemiologic methods and survey:** Data collection: observational (descriptive and analytical) and experimental studies. Epidemiology study designs - case control and cohort studies (prospective and retrospective), techniques of sampling and matching, sources of bias.

Unit-VIII: Data Organization & Presentation, Statistical Modeling and analysis using 'R' on NCRP data and survey conducted by the students: Basic principles of 'R' software for tabulation and graphical representations, measures of central tendency, dispersion and skewness. **Statistical modeling and analysis using 'R' on NCRP data and survey conducted by the students:** Correlation analysis (scatter diagrams and Karl Pearsons coefficient of determination, standard and probable errors) and regression analysis. Inferential statistics: sampling distributions and standard error null and alternate hypothesis, basic concept and illustrations of type I and type II errors, concept of confidence interval estimation, large sample tests for single mean and difference of means, single proportion and difference of proportions, students t-distribution (test for single mean, difference of means and paired t-test), chi-square distribution, F-distribution, one-way and two-way ANOVA, non parametric analysis (sign and rank tests), p-value.

DSE4P: Community medicine, Epidemiological Data Analysis (Practical) Credits 02

List of Practical

1. Surveys/ Community based studies on the topics related to preventive and social medicine.
2. Designing a questionnaire for survey of prevalence diabetes/ hypertension/ allergy/ respiratory disorders/etc. Determining the target and control populations
3. Surveying the population for the diseases mentioned above.
4. Analysis of data from National Cancer Registry Program (NCRP). Understanding incidence, mortality (rates, ratios and proportions).

5. 'R' software and analysis of data from NCRP data and survey conducted by the students. Correlation studies. Regression studies. Probabilistic distribution studies. Comparison of groups and ascertaining statistical significance of differences.

Or

DSE-4: Patho-physiological Basis of Diseases

Credits 06

DSE4T: Patho-physiological Basis of Diseases

Credits 04

Course Contents:

Unit-I: Introduction - History of pathology, Basic definitions and common terms used in pathology, Survival mechanism and disease, microscopic and cellular pathology, scope and techniques used.

Unit-II: Cell Injury and responses of cells: Cellular Adaptations and Cell Death - An overview of cellular adaptation: Hyperplasia, Hypertrophy, Atrophy, Metaplasia; Causes and mechanisms of cell injury, reversible and irreversible injury, Necrosis, Apoptosis, Types of apoptosis, Intracellular accumulations, Cellular ageing

Unit-III: Role of inflammation in disease (with suitable examples) - Basic concepts with suitable examples of general features of acute and chronic inflammation: vascular changes, cellular events, important chemical mediators of inflammation, Morphological effects inflammation response, granulomatus inflammation.

Unit-IV: Role of tissue repair healing and fibrosis (with suitable examples) - Basic mechanism of tissue regeneration, and repair by healing, scar formation and fibrosis

Unit-V: Common Hemodynamic Disorders in diseases (with suitable examples) - An overview of edema, hyperemia, congestion, hemorrhage, hemostasis and thrombosis, Embolism, Infarction and shock with suitable examples

Unit-VI: Nutritional diseases - Protein energy malnutrition, deficiency diseases of vitamins, minerals, nutritional excess and imbalances. Roles and effects of metals.

Unit-VII: Cancer - Definitions, Nomenclature, characteristics of benign and malignant neoplasms, grading and staging of cancer, biology of tumor growth, invasion and metastasis, carcinogens and cancer, concept of oncogenes, tumor suppressor genes, DNA repair genes and cancer stem cells.

Unit VIII: Infectious diseases epidemiology- Modes of infections with suitable examples. Overview of cause, extent, prevention, treatment and control of the diseases: Respiratory infections, Intestinal infections, Arthropod-borne infections, Zoonosis and Surface infections

DSE4P: Patho-physiological Basis of Diseases (Practical)

Credits 02

List of Practical:

1. Urine analysis: Gross examination of urine for colour, odour, etc. Abnormal constituents like protein, ketone bodies, glucose, blood, and urea.
2. Measuring Erythrocyte Sedimentation Rate (ESR).
3. Tissue Processing, embedding and sectioning. Staining and preparation of permanent histological slide.
4. Study of histological slides showing hypertrophy, hyperplasia, dysplasia, leukemia, cirrhosis and any common cancer.
5. Diagnostic tests for detection of various diseases – CRP, VDRL, RA, Pregnancy, Dengue (any three)
6. PCR based diagnostics (for any one disease).
7. Physiological data acquisition like temperature, EEG, ECG.

Or

DSE-4: Research Methodology and Design

Credits 06

DSE4T: Research Methodology and Design

Credits 04

Course contents:

Foundation of Research: Meaning, Objectives, Motivation of research. Research Methods vs. Methodology, Types of Research: Analytical vs. Descriptive, Quantitative vs. Qualitative, Basic vs. applied.

Planning of Research design and experiment, - Need for research design: Features of good design, important concepts related to good design- Observation and Facts, Prediction and Explanation, Development of Models. Developing a research plan: Problem identification, Experimentation, Determining experimental and sample design, working a proposal - Review of literature. Research hypothesis sampling and data collection.

Ethics in research - Code of ethics and research, Ethics and research process, Importance of ethics in research, bio-safety. Intellectual property Rights, Commercialization, Copy Right, Royalty, Patent law, Plagiarism, Citation, Acknowledgement.

Tools, techniques for research in Physiology and health science: Microscopy, Spectrophotometry, Spectrofluorometry- principles and application in biological research. Chromatography: Principles and uses of Paper chromatography; Column chromatography, TLC,

GLC, HPLC, Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography. Mass spectrometry, X-ray diffraction, X-ray crystallography: Basic principles and role in Characterization of proteins and nucleic acids. Electrophoresis: Principle, methods and uses of application of Agarose Gel Electrophoresis (AGE), PAGE, SDS-PAGE. Staining of DNA / RNA gel by ethidium bromide. Histology and Histopathology- principle and techniques. Karyotyping - techniques and staining. Cell fractionation – Cell fractionation techniques. Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl₂ gradient, analytical centrifugation, ultracentrifugation- principles, moving boundary and density gradient ultracentrifugation technique. Marker enzymes. Radioactivity – classification and properties. Concept of radiolabelling of biomolecules and their detection by autoradiography. Principles of radioimmunoassay (RIA), ELISA and immunoblotting.

DSE4P: Research Methodology and Design (Practical)

Credits 02

A Research project work on physiology/ or related health topics to be submitted based on any above tools and techniques. Formulation of the Project: meaning of scientific research and its methods, designing a project, types of project design, methods, tools and techniques, tabulation and interpretation.