

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

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
							2/1	
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
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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
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C6T: Circulation	Credits 04
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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 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 Practical:

Credits 02

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.