

## 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 Osmometers; 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, Atherosclerosis, 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

# Vidyasagar University

## 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		
<b>C3</b>	<b>C3T:</b> Physiology of Nerves & Muscle cells	Core Course-3		4	0	0	6	75
	<b>C3P:</b> Histological Study, Experiment of Nerve and Muscle	Core Course-3 [Practical]		0	0	4		
<b>C4</b>	<b>C4T:</b> Chemistry of Bio-molecules	Core Course-4		4	0	0	6	75
	<b>C4P:</b> Biological Chemistry (Practical)	Core Course-4 [Practical]		0	0	4		
<b>GE-2</b>	GE-2	GE					4/5	75
	GE-2	GE					2/1	
<b>AECC-2</b>	Environmental Studies	AECC					4	100
				<b>Total Credits =22</b>				

**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 ( $\text{AgNO}_3$ ) 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.



# Vidyasagar University

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

### 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**  
**C5T: Circulating Body Fluids**

**Credits 06**  
**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.