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 eukarytotic 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, viseosity, 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 themodynamis, 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, election microscopy, atomic force microscopy and fluorescence microscopy. Spectrophotometer.
  Principle of chromatography, ion exchange, gel filtration, GLC, TLC and immune-affinity chromatography. Electrphoresis: 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, bradicardia, tachycardia, Blood pressure -regulation, hypertension and hypotension, Athrosclerosis, ECG – principle, normal and abnormalities, Artifificial 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		
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.

Vidyasagar University

Curriculum for B.Sc (Honours) inPhysiology

[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 **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 determintation.

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, Malnutririon 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.