

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, 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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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.