DISCIPLINE SPECIFIC CORE COURSE -1 (DSC-1) BIOORGANIC CHEMISTRY

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Bioorganic Chemistry	4	3	0	1	Class XII with Chemistry	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- Bioorganic Chemistry is a discipline that integrates organic chemistry and biochemistry.
- It aims at understanding the relevance of biological processes using the fundamental concepts of organic chemistr
- This course includes basic principles of organic chemistry like concepts of stereochemistry and their importance understanding various bio-molecular reactions along with introduction to biomolecules

Learning outcomes

The Learning Outcomes of this course are as follows:

- By studying this course, the student will be able to identify, assess and analyze different types of stereoisomers and their properties in organic compounds and biomolecules
- They will understand the structures and function of biomolecules (carbohydrates, amino acids, lipids and nucleotide).
- Student will understand the mechanism of biologically significant name reaction and their role in biological systems.

SYLLABUS OF DSC-1

UNIT – I : Stereochemistry (2 Weeks)

Optical isomerism: Optical activity, specific rotation, enantiomerism, D and L designation, racemic modification, R and S sequence rules, diastereoisomers.
Conformational isomers: conformation of ethane and butane, inter conversion of projection formula, cyclohexane (mono- and di-substituted), resolution, optical purity.
Geometrical isomerism: Definition, nomenclature– E and Z

UNIT – II: Introduction to Biomolecules I (4 Weeks)

Monosaccharides- cyclization of aldoses and ketoses, conformations, concept of mutarotation, anomers, epimers.
Disaccharides- structure, reducing and non-reducing sugars. Polysaccharides- Starch, glycogen and cellulose.
Lipids:

Fattyacids, triacylglycerols, phospholipids, lipid bilayer formation, steroids (cholesterol)

UNIT – III: Introduction to Biomolecules II (6 Weeks)

Amino Acids:
Structure and classification of amino acids, ionization, chemistry of peptide bond, non-ribosomal peptide bond formation, essential and non-essential amino acids, amino acids as precursors of other bioactive compounds, zwitterion, isoelectric point, optical properties of amino acids, Definition of a peptide, peptide unit, peptide group, bond length, cis and trans conformation, primary, secondary (alpha helix, beta sheet, beta turn, collagen helix), tertiary and quaternary structures(with examples).
Nucleotides:
Sugars and Bases, conformation of sugar phosphate backbone, hydrogen bonding and tautomerism in nucleic acid bases
Effect of structure on reactivity of biomolecules.

UNIT – IV: Biologically Significant Name Reactions (3 Weeks)
Aldolcondensation (Glucogenesis), retro-aldol(Glycolysis),benzoincondensation (umpolung-decarboxylation of pyruvate in the presence of TPP), Claisen condensation (synthesis of fattyacids), Michael addition (Dehydrases),Cannizzaro (Sugar metabolism), Bayer Villiger reaction (FAD dependent ketone synthesis), Pinacol pinacolone rearrangement(1,2-carboncarbonshift)

Practical component
(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Qualitative tests for carbohydrates to identify the given unknown carbohydrate solution: Mohlisch, Barfoed, Fehling/ Tollen/ Benedict tests
2. Qualitative tests for carbohydrates to identify the given unknown carbohydrate solution: Iodine test, Selvinoff, Osazone, Bial's tests
3. Qualitative tests for Amino acids and Proteins: Ninhydrin, Xanthoproteic, Million's, Lead Acetate, Biuret test
4. Qualitative test for Fats
5. To determine the Iodine number of the given oil/fat.
6. To find pKa value of acetic acid
7. To study the titration curve of glycine
8. Absorption spectrum of Protein
9. Absorption spectrum of DNA
10. Estimation of a Reducing sugar in a given sample.

Essential/recommended readings

- Nelson, D. L. and Michael M. Cox (2021) 8th Edition. Lehninger Principles of Biochemistry. New Jersey, USA: Prentice Hall Publishers.ISBN-13:978-1319228002.
- Nasipuri, D. (2020), Stereochemistry of Organic Compounds: Principles and Applications, 4 th Edition, New Age International. ISBN 10: 9389802474
- Solomons, T. W. G.; Fryhle, C. B.; Snyder, S. A. (2017), Organic Chemistry, 12th Edition, Wiley. ISBN: 978-1-119-24897-2

- Plummer, D. (2017) An Introduction to Practical Biochemistry, 3rd edition. McGraw-Hill College; ISBN-13: 978-0070841659.

Suggestive readings:

- Hoffman, A. 8th Edition (2018). Wilson And Walker's Principles and Techniques of Biochemistry and Molecular Biology. Cambridge: Cambridge University Press. ISBN- 13: 9781316677056

DISCIPLINE SPECIFIC CORE COURSE -2 (DSC-2) CELL BIOLOGY

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Cell Biology	4	**3**	**0**	**1**	**Class XII Biology/Biotech**	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:

The objective is to offer detailed knowledge about the cells, its various components, processes and interactions with other cells:

- Structure and functions of various cellular compartments and organelles
- Fundamentals of transport of biomolecules inside the cell and its cytoskeleton
- Cell growth, cell-division and cell-cycle control mechanisms
- Cell to cell communications and participation of signal transduction pathways, in driving cell response mechanics

Learning outcomes

The Learning Outcomes of this course are as follows:

- Students will learn about how the cell has evolved and the basic types of cells present. Students will acquire insights into the composition and structure of cell membrane by navigating through various proposed cell models. Students will also learn the functions in detail about the processes of transport across cell membranes.
- Students will learn about the structure and function of various cellular compartments and organelles along with the concept of protein sorting and distribution in unique ways. Students will understand the association between cells through unique types of communication and developing junctions for attachment between neighbouring cells.
- Students will understand various cytoskeleton elements and their participation in maintaining cell shape and integrity. Students will gain knowledge about an overview of cell response to its environment, and involvement of cell- cell signalling mechanisms and to study signal transduction pathways.

SYLLABUS OF DSC-2

Unit I: The Cell (01 Week)

Historical background, significant landmarks, cell theory, structure of prokaryotic and eukaryotic cells

Unit II: Cell Membrane and Membrane Transport (03 Weeks)

Functions, different models of membrane structure, types of membrane lipids, membrane proteins: types, methods to study membrane proteins (detergents, RBC ghosts), RBC membrane as a model, membrane carbohydrates, membrane asymmetry and fluidity, lipid rafts. Transport of small molecules: Passive transport (simple diffusion and facilitated diffusion) and active transport and their types (P, V, F and ABC transporter) with example of Na+/K+ pump. Transport of macromolecules: Endocytosis (pinocytosis, phagocytosis), exocytosis

Unit III: Cell Organelles (03 weeks)

Structure and functions of various organelles:

- Nucleus: Different components, nuclear envelope- its structure, pore complex, nucleocytoplasmic, interaction (NLS and NES), nucleolus- structure and functions.
- Endoplasmic reticulum: RER- Biosynthesis and processing of proteins, co-translational and post-translational transport of proteins, signal hypothesis, protein sorting. SER- detoxification, biosynthesis of membrane, carbohydrate metabolism, steroid synthesis.
- Golgi apparatus: Golgi stack (cis, trans and medial cisternae), flow of proteins through Golgi body, glycosylation and protein sorting.
- Lysosomes: Development of different forms of lysosomes, role in cellular digestion, lysosomal storage diseases- Hurler syndrome, Hunter syndrome, Tay-Sachs disease and Inclusion cell disease (I-cell disease).
- Peroxisomes: Assembly, functions- H2O2 metabolism, oxidation of Fatty acids, glyoxysomes
- Mitochondria: Detailed structure, endosymbiotic theory, its genome and functions in brief
- Chloroplast: Detailed structure, its genome and functions in brief

Unit IV: Cell -Cell communication (01 Weeks)

Structures and functions of different types of anchoring junctions (desmosomes and hemidesmosomes), tight junctions, communication junctions (gap junction and plasmodesmata).

Unit V: Cytoskeletal Elements (01 Weeks)

Structure, assembly and functions of:

A. Microtubules: Axonemal and cytoplasmic microtubules (cilia, flagella, centrioles, basal bodies).
B. Microfilaments: Globular and filamentous actin, general idea about myosin.

Intermediate filaments: Different classes.

Unit VI: Cell Signaling and Cell Cycle (02 Weeks)

Signaling molecules and their receptors (extracellular and intracellular), functions of extracellular receptors; Intracellular signal transduction pathways (cAMP, cGMP, steroid hormone response element). Different phases of cell cycle and their significance, mitosis and meiosis, checkpoints and regulation of cell cycle.

Practical component

(Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Light microscopy: Principle, construction and types. Study of positive and negative staining using photomicrographs.
2. Fluorescence microscopy: principle and applications. Concept of GFP
3. Electron microscopy: Principle, construction and types. Study of positive and negative staining, freeze fracture, freeze etching, shadow casting, endocytosis, exocytosis and phagocytosis using electron micrographs
4. To explain mitosis and meiosis using permanent slides.
5. To measure cell size using a stage micrometer.
6. To cytochemically demonstrate presence of total and basic proteins in cheek cells or onion peel using mercuric bromophenol blue or fast green.
7. To cytochemically demonstrate presence of carbohydrates in cheek cells or onion peel using periodic acid Schiff's reagent.
8. To cytochemically demonstrate presence of DNA in cheek cells or onion peel using Feulgen reagent.
9. To study the effect of isotonic, hypotonic and hypertonic solutions on cells

Essential/recommended readings

- Cooper, G. M. (2018). 8th Edition. *The cell: A molecular approach*. Massachusetts, USA: Sinauer Associates. ISBN-13:978-1605357072
- Hardin, J. Bertoni, G. P. Kleinsmith, L.J. and Becker, W.M. (2016). 9th Edition. *The world of the cell.* San Francisco, USA: Benjamin Cummings Publishers, ISBN-13: 978 -0321934925.
- Karp, G. (2019). 9th Edition. *Cell and molecular biology:* New Jersey, USA: Wiley Publishers. ISBN-978—1-119-59816-9.

Suggestive readings:

- Cooper, G. M. and Hausman, R. E. (2013). 6th Edition. *The cell: A molecular approach*. Massachusetts, USA: Sinauer Associates. ISBN-13:978-1605351551
- Hardin, J. Bertoni, G. P. Kleinsmith, L.J. and Becker, W.M. (2008). 7th Edition. *The world of the cell.* San Francisco, USA: Benjamin Cummings Publishers, ISBN-13: 978 0805393934.
- Karp, G. (2013). 7th Edition. *Cell and molecular biology: Concepts and experiments.* New Jersey, USA: Wiley Publishers. ISBN-978-0470483374.
- Alberts, B et al. (2014). 6th edition. *Molecular Biology of the Cell*. W. W. Norton & Company. ISBN-13 : 978-0815345244
- Lodish H et al. (2003). 5th Revised edition. *Molecular Cell Biology*. W.H.Freeman& Co Ltd; ISBN-13 : 978 0716743668

DISCIPLINE SPECIFIC CORE COURSE -3 (DSC-3) HUMAN PHYSIOLOGY AND ANATOMY I

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Human Physiology and Anatomy I	**4**	**3**	**-**	**1**	**Class XII pass with Physics, Chemistry and Biology as papers in Class XII.**	**NA**

Learning Objectives

The Learning Objectives of this course are as follows:

- The course curriculum is a systematic presentation of physiological concepts to ensure appropriate depth and breadth of basic functioning of the human body and its interrelations with respect to heart, lung, kidney, gonads, endocrine glands and digestive system.
- It would give students exposure of physiological concepts needed as foundations for further studies in pharmacology, pathology and pathophysiology etc.
- It would provide a base to understand body defenses and the mechanisms of deranged function of human body
- The curricular objectives are focused primarily on normal body function. Accordingly, wherever possible clinical examples have been illustrated to the underlying physiological principles.

Learning outcomes

The Learning Outcomes of this course are as follows:

Having successfully completed this course, students shall be able to learn and appreciate:

- The usefulness of dividing the human body in different anatomical planes and sections, cavities, along with the role of feedback system in maintaining homeostasis. Functional anatomy of the epithelial and connective tissues while focusing on integumentary and skeletal system. Overview of structure, types and function of cartilage, bone and joints.
- Structure, function and regulation of components/different formed elements of blood and the mechanism of clotting. Students would be able to understand different blood groups, basis of their classification, their importance in blood transfusions and tissue grafting and basic concepts of blood and bleeding disorders
- Student would be able to understand neurons their role and significance and how as apart of the brain they help in brain physiology. Appreciation of basic concepts of action potential/ graded potential in the conduction of nerve impulse. Action and significance of different neurotransmitters at the synapse

along with the mechanism of synaptic transmission using different ligand gated ion channels, G protein coupled receptors and their ligands as example.

- Students would learn organization of brain, with identification of structures and functionof different brain regions. Identify different neural pathways and explain their significance. They would understand the innate responses and conditioned response of day today life by studying autonomic nervous system and effect of its stimulation on different organs.

- The five senses which help an individual to perceive the world would be studied in detail. Stimulus modality, sensory adaptation and the role of generator potential in the sensory physiology of touch, gustation, olfaction, hearing and vision. They would recognize and explain the common disorders related to the senses.

- Students would be able to describe and distinguish between the structure, mechanism and regulation of contraction of skeletal, cardiac and smooth muscles. Enlist the energy requirements, characteristic features of different muscle fibers and their role in generating muscle tension. Demonstrate the concept of muscle fatigue, adaptation to physical training, and muscle degeneration and associated disorders.

SYLLABUS OF DSC-3:

Unit I: Body organization and Integumentary system 03 Weeks

General Anatomy of the body, Introduction to various kinds of body planes, cavities and their membranes, Tissues level of organization (Types, origin, function & repair). Structure and functions of human skin.

Unit II: Blood (02 Weeks)

Composition and Function of Blood and its components (RBC, WBC, platelets and plasma). Hematopoiesis, Hemoglobin structure, function and abnormal hemoglobin. Basic concepts about Anemia and types. Blood Hemostasis (blood coagulation/ clotting, platelet function and role of endothelium).

Unit III: Nerve physiology (02 Weeks)

Structure, function and types of neuron, conduction of nerve impulse, Resting membrane potential, Action and graded potential. Synapse its types, Synaptic Transmission, Neurotransmitters and their receptors; types and function

Unit IV: Nervous System I: Organization of nervous system (02 Weeks)

Structure, function and organization of Central nervous system, Peripheral nervous system and Autonomic nervous system. Motor physiology: Reflexes, types and reflex arch

Unit V: Nervous System II: Sensory Physiology (03 Weeks)

Concept of receptors in the body and their types, structure, functional anatomy, regulation and common disorders of the following sensations: Vision, Hearing, Taste, Smell and other senses (Touch, Pain, Temp).

Unit VI: Muscular system (01 Weeks)

Functional anatomy of muscular system, types of muscles, neuromuscular junction structure property and transmission, General characteristics, molecular mechanism and properties of skeletal muscle excitation and contraction, energetics and characteristics of whole muscle contraction.

Unit VII: Skeletal System (02 Weeks)

Cartilage: structure, types and function. Bones: structure, function, location and types. Joints: structure, function and types

Practical component

(Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Estimation of haemoglobin (Sahli's method)
2. Determination of total erythrocyte count.
3. Determination of total leukocyte count.
4. Preparation of blood smears and identifying various WBC
5. To perform differential leukocyte count of blood.
6. To study a simple reflex arc
7. To study the sensation of taste, touch and smell.
8. To study different human organs and their sections through permanent histological slides T. S. of brain, spinal cord, skeletal fibres, cardiac muscles, skeletal muscles, cartilage joints and different tissues. (Minimum 8 slides covering the systems mentioned in theory.)

Essential/recommended readings:

- Principles of Anatomy and Physiology, 16th edition (2020), Gerard J. Tortora and Bryan H. Derrickson; Wiley and Sons, ISBN: 978-1-119-66268-6.(e book),ISBN: 978-1-119-70438-6 (for print book).
- Ganong'sReviewofMedicalphysiology,26thedition(2019),K.E.Barett,S.M.Barman,S. Boitano and H. Brooks; Tata McGraw Hill, ISBN 978-1-260-12240-4 (for print book) ISBN: 978-1-26-012241-1(for eBook)
- Textbook of Practical Physiology, 9th edition (2018), CL Ghai; Jaypee Publication, ISBN-13: 978-9352705320 ISBN-10: 9352705327

Suggestive readings:

- Guyton and Hall Textbook of Medical Physiology, 12th edition (2011), J. E. Hall; W B Saunders and Company, ISBN: 978-1-4160-4574-8 International Edition: 978-0-8089-2400-5
- Human Physiology, 12thedition (2011), Stuart I. Fox; Tata McGraw Hill, ISBN 978–0–07–337811–4MHID 0–07–337811–9.