Department Of Biochemistry

Four-Year UG Program (FYUP) NEP-Based

B. Sc. Biochemistry

Course Contents & Syllabus

(w.e.f. 2026-27)

Hemvati Nandan Bahuguna Garhwal University
(A Central University)
Srinagar Garhwal-246174 (Uttarakhand)

Course Category	Semester-I					Semester-II				
	Subject / Title	Paper Name	No. of Paper	Credits		Subject / Title	Paper name	No. of Paper	Credits	
				T	P				T	P
Discipline Specific Core	DSC -I (Major)	Chemical foundation of Life	1	3	1	DSC-II (Major)	Biology of the Cell	1	3	1
	DSC-I (Minor)	Biomolecules	1	3	1	DSC-II (Minor)	Concepts of Cell Biology	1	3	1
MD/ID (Minor)-1 Subject	MD/ID (M)-I	Molecules of Life	1	3	1	MD/ID (M)-II	Cell biology	1	3	1
MD/ID (General)	MD/ID (G)-I		1	3	-	MD/ID (G)-II		1	3	-
SEC / AEC	AEC-Communication Skills or AMSC		1	3	-	AMSC or AEC-Communication Skills		1	3	-
VAC	Understanding and connecting with environment Or Life Skills & personality development		1	2	--	Understanding and connecting with environment Or Life Skills & personality development		1	2	-
Total			**6**	**17**	**3**			**6**	**17**	**3**

Course Category	Semester-III					Semester-IV				
	Subject / Title	Paper Name	No. of Paper	Credits		Subject / Title	Paper Name	No. of Paper	Credits	
				T	P				T	P
Major-I (One Subject)	DSC (Major)-III	Foundations of Molecular Biology	1	4	1	DSC (Major)-V	Fundamentals of Enzymology	1	4	1
Minor-I (One Subject)	DSC (Minor)-III	Introduction to Molecular Biology	1	3	1	DSC (Minor)-IV	Introduction to Enzymology	1	3	1
SEC	SEC (Major)-IV	Basic Biochemical Techniques	1	2	1	SEC (Major)-VI	Advanced Biochemical Techniques	1	2	1
M.D/I.D (Minor)	M.D/I.D (M)-III	Concepts of Molecular Biology	1	3	1	M.D/I.D (M)-IV	Enzymology	1	3	1
AEC (Language based courses)	Indian, Modern, Regional Language-I		1	2	-	Indian, Modern, Regional Language-II		1	2	-
VAC/AEC	AEC-Indian Knowledge System Or VAC-Culture, traditions and moral values		1	2		AEC-Indian Knowledge System Or VAC-Culture, traditions and moral values		1	2	-
Total			**6**	**16**	**4**			**6**	**16**	**4**

Course Type	Semester-V					Semester-VI				
	Subject/Title	Name of paper	No. of paper	Credits		Subject/Title	Name of paper	No. of paper	Credits	
				T	P				T	P
Major-I (One)	DSC (Major)-VII	Introduction to Metabolism	1	4	2	DSC (Major)-X	Outlines of Immunology	1	4	2
	DSC (Major)-VIII	Clinical Biochemistry	1	4	2	DSC (Major)-XI	Biotechnology and Genetic Engineering	1	4	2
	DSE (Major) Elective-I	Gene Expression & Regulation	1	4	-	DSE (Major) Elective-II	Industrial Biotechnology	1	4	-
		Modern Molecular Tools & Techniques					Animal Cell culture: Principle and applications			
	(Major) Industrial visit/ Vocational/ Internship/SEC-IX	Industrial visit/Internship	1	4		(Major)-Project Report/or Community outreach project/SEC-XII	Project Report/Community outreach project	1	4	
Minor (One)	(Minor)-V Industrial visit/SEC/or Vocational/ or Community outreach project	Biochemistry in Health and Disease	1	4		Minor-VI	Basics of Biotechnology and Genetic Engineering	1	4	
Total			**5**	**20**	**4**			**5**	**20**	**4**

Course Type	Semester-VII					Semester-VIII				
	Subject/Title	Name of paper	No. of paper	Credits		Subject/Title	Name of paper	No. of paper	Credits	
				T	P				T	P
Major Subject (One)	**DSC (Major) -XIII**	Plant Biochemistry	1	3	1	**DSC (Major) - XVII**	Advanced Metabolism	1	3	1
	DSC (Major) –XIV	Human Physiology	1	3	1	**DSC (Major) - XVIII**	Nutritional Biochemistry	1	3	1
	DSC (Major) –XV	Biochemical and Biophysical techniques	1	3	1	**DSC (Major) – XIX**	Bio-membranes and Bioenergetics	1	3	1
	DSC (Major) –XVI	Neurobiochemistry	1	3	1	**DSC (Major) –XX**	Cancer pathogeneses and therapy	1	3	1
	DSE (Major) Elective –III	Biosafety, Laboratory safety and IPR	1	3	1	**DSE (Major) Elective –IV**	Applied Microbiology	1	3	1
		Basics of plant tissue culture					Introduction to Biostatistics			
Minor (One)	**(Minor)–VII Or M.D/I.D. (M)-V**	Fundamentals of Plant Biochemistry	1	3	1	**(Minor)–VIII Or M.D/I.D. (M)-VI**	Basics of Nutritional Biochemistry	1	3	1
Total			6	18	6			6	18	6

Fourth Year UG (Honours with Research) who meet a minimum CGPA of 7.5

Course Type	Semester-VII					Semester-VIII				
	Subject/Title	Name of paper	No. of paper	Credits		Subject/Title	Name of paper	No. of paper	Credits	
				T	P				T	P
Major Subject (One)	**DSC (Major) -XIII**	Plant Biochemistry	1	3	1	**DSC (Major)-XVII**	Advanced Metabolism	1	3	1
	DSC (Major) –XIV	Human Physiology	1	3	1					
	DSC (Major) –XV	Biochemical and Biophysical techniques	1	3	1					
	DSC (Major)- XVI	**Research Methodology**	1	4	-	**DSC-(Major)-XVIII**	**Dissertation**	1		12
	DSE (Major) Elective-III	Biosafety, Laboratory safety and IPR	1	3	1	**DSE (Major) Elective -IV**	Applied Microbiology	1	3	1
		Basics of plant tissue culture					Introduction to Biostatistics			
Minor (One)	**Minor)–VII Or M.D/I.D. (M)-V**	Fundamentals of Plant Biochemistry	1	3	1	**(Minor)–VIII Or M.D/I.D. (M)-VI**	Basics of Nutritional Biochemistry	1	3	1
Total			6	19	5			4	9	15

B.Sc. BIOCHEMISTRY (NEP)

SEMESTER - I

DSC-I (Major) Chemical Foundation of Life

UNIT I The Foundations Of Biochemistry And Water

Cellular and chemical foundations of life; organization and classification of biomolecules. Unique physicochemical properties of water; weak interactions in aqueous systems including hydrogen bonding, van der Waals forces, and ionic interactions. Ionization of water, pH, pKa, buffers and buffering action, Henderson–Hasselbalch equation. Water as a reactant in biochemical processes; suitability of aqueous environment for biological systems.

UNIT II Carbohydrates and Lipids

Structure and classification of carbohydrates: monosaccharides including aldoses and ketoses;. Stereochemistry of carbohydrates including enantiomers, epimers, anomers, and D- and L-configurations. Ring formation (pyranose and furanose forms), conformations, and mutarotation. Chemical reactions of carbohydrates including oxidation, reduction, and glycoside formation. Disaccharides (maltose, lactose, sucrose) with emphasis on glycosidic linkages and reducing and non-reducing nature. Structural and storage polysaccharides (starch, glycogen, cellulose, chitin) and their structure–function relationships..

Definition and classification of lipids. Structure and properties of fatty acids including essential fatty acids. Storage lipids (triacylglycerols and waxes). Physicochemical properties of lipids including saponification number and iodine number. Structural lipids including glycerophospholipids, sphingolipids (ceramide), and sterols (cholesterol and phytosterols). Biological significance of lipids in membrane structure, fluidity, and cellular signalling.

UNIT III Amino acids and Proteins

Structure and classification of amino acids; essential and non-essential amino acids; physical, chemical, and optical properties; zwitterionic nature and isoelectric pH. Peptide bond: formation, characteristics, and stability.
Protein structure: levels of protein organization—primary, secondary (α-helix and β-pleated sheet), tertiary, and quaternary structures; forces stabilizing protein structure (hydrogen bonds, ionic interactions, hydrophobic interactions, and disulfide bonds).

UNIT IV Nucleic acids and Vitamins

Structure and properties of nucleotides; nitrogenous bases, pentose sugars, and phosphates. Watson–Crick model of DNA; structure of RNA (mRNA, tRNA, rRNA). Concept of DNA denaturation

Classification and structure of water-soluble and fat-soluble vitamins; biochemical functions; deficiency diseases and hypervitaminosis.

Lab Course: DSC-I (Major) Chemical Foundation of Life

1. Laboratory safety measures and good laboratory practices.

2. Preparation of normal, molar and percent solutions
3. Preparation of buffers.
4. Qualitative tests for carbohydrates, lipids, amino acids and proteins.
5. Acid–base titration (standardization and estimation)
6. Determination of pH of given solutions using pH paper/pH meter.
7. Estimation of vitamin C by the titrimetric method.

Any other practical as per the facility available in the department.

DSC-I (Minor) Biomolecules

UNIT I The foundations of biochemistry and water

Biomolecules and their classification; weak interactions in aqueous systems; ionization of water, pH, and buffers; role of water as a reaction medium. Henderson–Hasselbalch equation. Water as a reactant in biochemical processes; suitability of aqueous environment for biological systems.

UNIT II Carbohydrate and Lipids

Structure and classification of carbohydrates, stereochemistry, and interrelationships of monosaccharides; ring forms and mutarotation. Sugar derivatives; disaccharides and trisaccharides; structural polysaccharides.

Structure and classification; fatty acids, glycerol, and sphingosine; physicochemical properties including saponification and iodine number. Sterols, bile acids, and cholesterol; functional roles of lipids.

UNIT III Amino acids and Proteins

Structure and basic classification of amino acids; essential and non-essential amino acids. Zwitterionic nature and isoelectric point. Peptide bond and its basic characteristics. Overview of protein structure including primary, secondary, tertiary, and quaternary levels, and general forces stabilizing protein structure.

UNIT IV Nucleic acids and vitamins

Components of nucleotides including nitrogenous bases, pentose sugar, and phosphate group. Basic structure of DNA (Watson–Crick model) and types of RNA (mRNA, tRNA, rRNA) with their functions. Concept of DNA denaturation

Classification and structure of water-soluble and fat-soluble vitamins; biochemical functions; and deficiency diseases.

Lab Course: DSC-I (Minor) Biomolecules

1. Laboratory safety measures and good laboratory practices.
2. Preparation of normal, molar and percent solutions
3. Preparation of buffers.
4. Qualitative tests for carbohydrates, lipids, amino acids and proteins.
5. Acid–base titration (standardization and estimation)

6. Determination of pH of given solutions using pH paper/pH meter.
7. Estimation of vitamin C by the titrimetric method.

Any other practical as per the facility available in the department.

MD/ID (Minor)-1 Molecules Of Life

UNIT I: Foundations of Biochemistry and Water

Basic concept of biomolecules and their classification. Importance of water in biological systems and its unique properties. Weak interactions in aqueous systems including hydrogen bonding and ionic interactions. Concept of pH and buffers. Role of water as a solvent and medium for biochemical reactions.

UNIT II: Carbohydrates and Lipids

Basic structure and classification of carbohydrates including monosaccharides (aldoses and ketoses), disaccharides, and polysaccharides. Biological importance of carbohydrates. Introduction to lipids, their classification, and basic structure of fatty acids. Storage lipids such as triacylglycerols and their role in energy storage. Structural lipids and their importance in biological membranes.

UNIT III: Amino Acids and Proteins

Basic structure and classification of amino acids, including essential and non-essential amino acids. Concept of peptide bond. Introduction to proteins and levels of protein organization (primary to quaternary).

UNIT IV: Nucleic Acids and Vitamins

Basic structure of nucleotides and nucleic acids. General idea of DNA and RNA and their functions. Classification of vitamins and their importance in maintaining health, including deficiency conditions.

Lab Course: MD/ID (Minor)-1 Molecules Of Life

1. Laboratory safety measures and good laboratory practices.
2. Preparation of normal, molar and percent solutions
3. Preparation of buffers.
4. Qualitative tests for carbohydrates, lipids, amino acids and proteins.
5. Acid–base titration (standardization and estimation)
6. Determination of pH of given solutions using pH paper/pH meter.
7. Estimation of vitamin C by the titrimetric method.

Any other practical as per the facility available in the department.

SEMESTER – II

DSC-II (Major): Biology of the Cell

UNIT I: An Overview of Cells

Cell theory and its modern concepts. Structural organisation of prokaryotic and eukaryotic cells; cell size, shape, and surface-to-volume ratio. Acellular and minimal cellular systems, including viruses (phages), viroids, mycoplasma, and Escherichia coli. Comparative features of plant and animal cells. Basic structure and composition of plant and bacterial cell walls.

UNIT II: Cell organelles

Ultrastructure and functions of the nucleus, nuclear envelope, nuclear pore complex, nucleolus, and nuclear lamina. Structure and functions of mitochondria and chloroplasts, including their semiautonomous nature and genome organization. Organization and functions of ribosomes, endoplasmic reticulum (RER and SER), and Golgi apparatus; Introduction to protein targeting, sorting, and post-translational modifications. Structure and functions of lysosomes and peroxisomes. Vesicular transport mechanisms including endocytosis and exocytosis

UNIT III: Membrane Structure and Transport

Fluid mosaic model of membrane structure and membrane dynamics. Membrane permeability and factors affecting transport. Passive transport: simple diffusion, and facilitated diffusion. Active transport: primary active transport (Na^+/K^+-ATPase) and secondary active transport (symport and antiport). Ion channels: structure, gating mechanisms, and physiological significance.

UNIT IV: Cytoskeleton, Cell Cycle, and Cell Death

Organization and functions of cytoskeletal components: actin filaments, intermediate filaments, and microtubules. Actin–myosin interactions and role of motor proteins (kinesin, dynein) in intracellular transport and cell motility. Cell cycle: phases (G_1, S, G_2, M), checkpoints, and basic regulatory mechanisms. Overview of apoptosis and its biological significance.

Lab Course: DSC-II (Major): Biology of the Cell

1. Basic staining techniques (e.g., methylene blue staining)
2. Study of prokaryotic and eukaryotic cells using permanent slides
3. Comparative study of plant and animal cells (onion peel and cheek cell smear)
4. Demonstration of cell fractionation techniques
5. Determination of osmotic behaviour of cells (plasmolysis and deplasmolysis in plant cells)
6. Enzyme localization: assay of succinate dehydrogenase in mitochondrial fraction
7. Study of mitosis using permanent slides.

Any other practical based on departmental facilities

DSC-II (Minor) Concepts of Cell Biology

UNIT I: Introduction to Cell Biology

Prokaryotic and eukaryotic cells; comparative features of plant and animal cells. Basic concepts of cell size and shape. Basic structure and composition of plant and bacterial cell walls.

UNIT II: Cell Organelles

Structure and functions of the nuclear envelope, nuclear pore complex, and nucleolus; nucleocytoplasmic transport (overview). Organization and functions of endoplasmic reticulum (including smooth and rough ER) and Golgi apparatus. Structure and functions of mitochondria, chloroplasts, lysosomes, and peroxisomes. Basic concepts of protein targeting and vesicular transport.

UNIT III: Membrane Transport

Basic structure of the cell membrane. Simple diffusion and facilitated transport (symport, antiport, uniport). General mechanisms of active and passive transport. Role of ion channels in membrane transport.

UNIT IV: Cytoskeleton and Cell Cycle

Organization of actin filaments, intermediate filaments, and microtubules; their role in maintaining cell shape and movement. Overview of the cell cycle and its phases. Overview of apoptosis and its biological significance.

Lab Course: DSC-II (Minor) Concepts of Cell Biology

1. Study of prokaryotic and eukaryotic cells using permanent slides
2. Comparative study of plant and animal cells (onion peel and cheek cell smear)
3. Study of cell organelles using charts/models/virtual lab resources
4. Demonstration of cell fractionation techniques
5. Determination of osmotic behaviour of cells (plasmolysis and deplasmolysis in plant cells)
6. Study of diffusion and osmosis using simple experimental setups
7. Observation of mitosis using permanent slides
8. Enzyme localization: assay of succinate dehydrogenase in mitochondrial fraction
9. Basic staining techniques (e.g., methylene blue staining)

Any other practical based on the facilities available in the department

MD/ID (Minor)-II Cell Biology

UNIT I: Introduction to Cell Biology

Cell morphology. Prokaryotic and eukaryotic cell organisation. Comparative features of plant and animal cells. Basic structure and composition of plant and bacterial cell walls.

UNIT II: Cell Organelles

Overview of nucleus, endoplasmic reticulum, Golgi apparatus, lysosomes, mitochondria, chloroplasts, and peroxisomes with emphasis on basic structure and functions. Basic concepts of protein targeting and vesicular transport.

UNIT III: Membrane Transport

Basic mechanisms of simple diffusion, facilitated diffusion, and active transport. General mechanisms of active and passive transport. Role of ion channels and membrane permeability in transport processes.

UNIT IV: Cytoskeleton and Cell Cycle

Basic components of the cytoskeleton including actin filaments, intermediate filaments, and microtubules. Overview of the cell cycle. Overview of apoptosis and its biological significance

Lab Course: MD/ID (Minor)-II Cell Biology

1. Study of plant and animal cells using temporary mounts (onion peel and cheek cells)
2. Observation of prokaryotic and eukaryotic cells using charts/photomicrographs
3. Study of mitosis using permanent slides
4. Demonstration of cell organelles using models/charts/virtual labs
5. Study of diffusion and osmosis using simple experimental setups
6. Demonstration of plasmolysis and deplasmolysis in plant cells
7. Basic staining techniques (e.g., methylene blue staining)
8. Enzyme localization: assay of succinate dehydrogenase in mitochondrial fraction
9. Any other practical based on the facilities available in the department

SEMESTER – III

DSC (Major)-III Foundations of Molecular Biology

UNIT I: Structure and Organisation of Genetic Material

Genome and its organisation. Structure and chemical composition of nucleic acids (DNA and RNA). Different forms of DNA (A-DNA, B-DNA, Z-DNA). Evidence for DNA as genetic material: Griffith's experiment; Avery, MacLeod and McCarty experiment; Hershey–Chase experiment. DNA denaturation and renaturation; melting temperature (Tm). Definition of a gene and concept of the C-value paradox.

UNIT II: DNA Replication and Repair

Central dogma of molecular biology. DNA replication in prokaryotes: semiconservative (Meselson and Stahl experiment) and bidirectional nature. Replication fork and mechanism of replication. Enzymes involved in DNA replication: DNA polymerase, helicase, primase, ligase, and topoisomerase. Leading and lagging strand synthesis and Okazaki fragments. Basic concepts of DNA repair mechanisms including excision repair, mismatch repair, photoreactivation, and SOS repair.

UNIT III: Transcription

Transcription in prokaryotes. Structure and function of RNA polymerase and role of sigma factor. Promoter regions and stages of transcription: initiation, elongation, and termination. Inhibitors of transcription. Structure and function of tRNA.

UNIT IV: Genetic Code and Translation

Genetic code: definition and features, triplet nature, codons, and wobble hypothesis. Translation: components of protein synthesis machinery, ribosome structure and assembly, charging of tRNA, and mechanism of protein synthesis in prokaryotes (initiation, elongation, termination).

Lab Course: DSC (Major)-III Foundations of Molecular Biology

1. Determination of absorption spectra of DNA and protein using UV–Visible spectrophotometer
2. Estimation of DNA by diphenylamine method
3. Determination of OD ratio (A260/A280) for DNA and protein samples
4. Preparation of standard DNA solution and dilution techniques
5. Isolation of genomic DNA from plant/animal tissue
6. Assessment of the purity of the DNA sample
7. Agarose gel electrophoresis of DNA

Any other practical based on the facilities available in the department

DSC (Minor)-III Introduction to Molecular Biology

UNIT I: Basic Concepts and Structure of Genetic Material

Basic concepts of molecular biology. Genome organization. Structure and properties of nucleic acids (DNA and RNA). Different forms of DNA (A-DNA, B-DNA, Z-DNA). Evidence for DNA as genetic material. Central dogma of molecular biology.

UNIT II: DNA Replication and Repair

DNA replication in prokaryotes: features, semiconservative (Meselson and Stahl experiment) and bidirectional nature. Replication machinery and enzymes involved including DNA polymerases, helicase, primase, ligase, topoisomerase, and single-strand binding proteins. Leading and lagging strand synthesis and Okazaki fragments. Basic mechanisms of DNA repair, including mismatch repair and excision repair.

UNIT III: Transcription

Concept of transcription in prokaryotes. Transcription unit and promoter regions. Mechanism of transcription, including initiation, elongation, and termination. Structure and function of RNA polymerase.

UNIT IV: Genetic Code, and Translation

Genetic code: properties including triplet nature, degeneracy, universality, and wobble hypothesis. Codons and anticodons. Translation mechanism including initiation, elongation, and termination. Ribosome structure.

Lab Course: DSC (Minor)-III Introduction to Molecular Biology

1. Determination of absorption spectra of DNA and protein using UV–Visible spectrophotometer
2. Estimation of DNA by diphenylamine method
3. Determination of OD ratio (A260/A280) for DNA and protein samples
4. Preparation of standard DNA solution and dilution techniques
5. Isolation of genomic DNA from plant/animal tissue
6. Assessment of the purity of the DNA sample
7. Agarose gel electrophoresis of DNA

Any other practical based on the facilities available in the department

SEC (Major)-IV Basic Biochemical Techniques

UNIT I: Laboratory Practices and Solutions

Laboratory safety measures and good laboratory practices. Cleaning and calibration of glassware. Preparation of solutions: normality, molarity, and percentage solutions. Basic laboratory skills, including weighing, pipetting, and handling of instruments.

UNIT II: Cell Disruption and Basic Separation Techniques

Cell disruption techniques: tissue homogenization using mortar and pestle, mechanical homogenization, ultrasonication, and freeze–thaw methods. Basic separation techniques including dialysis and lyophilisation (freeze drying). Principles of precipitation methods: salting out using inorganic salts and isoelectric precipitation. Applications in biomolecule isolation.

UNIT III: Buffers and pH Measurement

pH scale and its biological significance. Measurement of pH using a pH meter. Henderson–Hasselbalch equation and its applications. Preparation of buffer solutions. Biological buffer systems with reference to blood, including the haemoglobin buffer system and the phosphate buffer system. Importance of buffers in maintaining physiological conditions.

UNIT IV: Centrifugation and Spectroscopic Techniques

Principle of centrifugation and its types: differential and density gradient centrifugation (rate zonal and isopycnic centrifugation). Applications in biological studies. Basic principles of electromagnetic radiation and interaction of light with matter. Beer–Lambert law and its application in UV–Visible spectroscopy. Components and working principles of UV–Visible spectrophotometer and colorimeter.

Lab Course: SEC (Major)-IV Basic Biochemical Techniques

1. Laboratory safety practices and handling of equipment
2. Preparation of normal, molar, and percentage solutions
3. Preparation of buffer solutions and pH determination using pH meter
4. Demonstration of cell disruption techniques (homogenization)
5. Dialysis experiment for separation of small and large molecules
6. Estimation of protein using colorimetric method (Lowry/Bradford)
7. Determination of absorbance using spectrophotometer and preparation of standard curve
8. Centrifugation for separation of components (demonstration/experiment)

Any other practical based on departmental facilities

MD/ID (Minor)-III: Concepts of Molecular Biology

UNIT I: Introduction and Structure of Genetic Material

Introduction to molecular biology. Basic structure of nucleotides including nitrogenous bases, pentose sugar, and phosphate group. Structure of DNA (Watson–Crick model) and base pairing rules. Overview of evidence for DNA as genetic material. Central dogma of molecular biology.

UNIT II: DNA Replication

Basic concept of DNA replication. Semiconservative nature of replication (Meselson and Stahl experiment). Replication fork, leading and lagging strands, and Okazaki fragments. Role of key enzymes including DNA polymerase, helicase, primase, and ligase (overview). Basic mechanisms of DNA repair.

UNIT III: Transcription

Concept of transcription. Transcription unit and promoter (basic idea). Steps of transcription: initiation, elongation, and termination (overview). Role of RNA polymerase.

UNIT IV: Genetic Code and Translation

Genetic code and its basic characteristics. Codons and anticodons. Overview of translation, including initiation, elongation, and termination. Role of ribosomes in protein synthesis.

Lab Course: MD/ID (Minor)-III: Concepts of Molecular Biology

1. Determination of absorption spectra of DNA and protein using UV–Visible spectrophotometer
2. Estimation of DNA by diphenylamine method
3. Determination of OD ratio (A260/A280) for DNA and protein samples
4. Preparation of standard DNA solution and dilution techniques
5. Isolation of genomic DNA from plant/animal tissue
6. Assessment of the purity of the DNA sample
7. Agarose gel electrophoresis of DNA

Any other practical based on the facilities available in the department.

SEMESTER – IV

DSC (Major)-V: Fundamentals of Enzymology

UNIT I: Introduction and Classification of Enzymes

Introduction to enzymes, historical development of enzymology, and general characteristics of enzymes. Features of enzyme catalysis and enzyme specificity. Enzyme nomenclature and IUB classification. Structure of enzymes and concept of active site. Cofactors and coenzymes: functions of TPP, NAD, NADP, and FAD. Isoenzymes and ribozymes. Concept of activation energy and transition state.

UNIT II: Enzyme Kinetics

Concept of enzyme–substrate complex and enzyme activity. Units of enzyme activity, specific activity, and turnover number. Michaelis–Menten equation and its significance. Lineweaver–Burk plot and Eadie–Hofstee plot. Significance of Km and Vmax. Factors affecting enzyme activity including pH, temperature, substrate concentration, and enzyme concentration.

UNIT III: Mechanism and Regulation of Enzyme Action

Mechanism of enzyme action: lock and key model and induced fit hypothesis. Types of catalysis, including general acid–base catalysis and covalent catalysis. Mechanism of action of chymotrypsin. Enzyme inhibition: competitive, non-competitive, and uncompetitive inhibition. Regulation of enzyme activity, including feedback inhibition and allosteric regulation. Multienzyme complexes with reference to the pyruvate dehydrogenase complex.

UNIT IV: Applied Enzymology

Applications of enzymes in medicine, food industry, and pharmaceutical industry. Immobilized enzymes: sources and techniques of immobilization including adsorption, covalent binding, and entrapment. Applications of immobilized enzymes. Biosensors with special reference to glucose oxidase biosensor: principles and clinical applications.

Lab Course DSC (Major)-V: Fundamentals of Enzymology

1. Study of amylase activity on starch
2. Determination of α-amylase activity in saliva
3. Effect of substrate concentration on enzyme activity
4. Effect of pH, temperature, and time on enzyme activity
5. Effect of salt concentration and metal ions on enzyme activity
6. Study of enzyme inhibition (basic demonstration)
7. Immobilization of enzyme using sodium alginate matrix

Any other practical based on departmental facilities.

DSC (Minor)-IV Introduction to Enzymology

UNIT I: Basics of Enzymes

Introduction to enzymes and their characteristics. Activation energy and transition state. Enzyme nomenclature and classification. General properties of enzymes and enzyme specificity. Cofactors and coenzymes with reference to TPP, NAD, and FAD. Isoenzymes (basic concept).

UNIT II: Enzyme Activity and Kinetics

Concept of active site and enzyme–substrate complex. Enzyme activity, international units, and turnover number (basic idea). Introduction to enzyme kinetics, Michaelis–Menten equation, and significance of Km and Vmax. Lineweaver–Burk plot. Factors affecting enzyme activity including pH, temperature, substrate concentration, and enzyme concentration.

UNIT III: Mechanism and Regulation of Enzymes

Basic theories of enzyme action: lock and key model and induced fit model. Enzyme inhibition: competitive, non-competitive, and uncompetitive inhibition. Feedback regulation of enzyme activity. Multienzyme complex with reference to pyruvate dehydrogenase.

UNIT IV: Applications of Enzymes

Allosteric regulation with reference to aspartate transcarbamoylase (introductory concept). Applications of enzymes in medicine, food industry, and pharmaceutical industry. Basic concept of immobilized enzymes and biosensors.

Lab Course: DSC (Minor)-IV Introduction to Enzymology

1. Study of amylase activity on starch
2. Determination of α-amylase activity in saliva
3. Effect of substrate concentration on enzyme activity
4. Effect of pH, temperature, and time on enzyme activity
5. Effect of salt concentration on enzyme activity
6. Effect of metal ions on enzyme activity (demonstration/experiment)
7. Basic enzyme inhibition study (demonstration)

Any other practical based on departmental facilities

SEC (Major)-VI: Advanced Biochemical Techniques

UNIT I: Chromatographic Techniques

Principle of chromatography; stationary and mobile phases. Paper chromatography and determination of Rf value. Thin-layer chromatography (TLC): principle and applications. Advanced chromatographic techniques including ion-exchange chromatography, affinity chromatography, and molecular sieve (gel filtration) chromatography. Introduction to high-performance liquid chromatography (HPLC) and gas chromatography (GC) with principles and applications.

UNIT II: Electrophoretic Techniques

Principle of electrophoresis, instrumentation, and factors affecting electrophoretic separation. Types of electrophoresis: paper electrophoresis, agarose gel electrophoresis, SDS-PAGE, isoelectric focusing, and two-dimensional electrophoresis.

UNIT III: Microscopy Techniques

Concepts of resolution and magnification. Optical microscopy: bright field, dark field, phase contrast, and fluorescence microscopy with principles and applications. Electron microscopy: principle, types (Transmission Electron Microscopy and Scanning Electron Microscopy), and basic sample preparation techniques.

UNIT IV: Diagnostic and Tracer Techniques

Tracer techniques and principles of radioactive decay. Units of radioactivity. Detection and measurement of radioactivity using Geiger–Müller counter and scintillation counter. Autoradiography and its applications. Applications of radioisotopes in biological and medical sciences.

Lab Course: SEC (Major)-VI: Advanced Biochemical Techniques

1. Separation of biological samples using paper chromatography
2. Separation of biological samples using thin-layer chromatography (TLC)
3. Spectroscopic analysis of unknown compounds using UV–Visible spectrophotometry
4. Handling and use of the microscope for visualization of biological samples
5. Separation of samples using centrifugation
6. Demonstration of agarose gel electrophoresis
7. Determination of Rf value in chromatography

Any other practical based on departmental facilities.

M.D/I.D (M)-IV: Enzymology

UNIT I: Introduction to Enzymes

Introduction to enzymes and their importance in biological systems. Basic characteristics of enzymes. Concept of activation energy and role of enzymes in catalysis. Enzyme classification and enzyme specificity. Introduction to cofactors and coenzymes with examples (NAD, FAD).

UNIT II: Enzyme Activity

Concept of enzyme activity and enzyme–substrate interaction. Enzyme activity, international units, and turnover number. Introduction to enzyme kinetics, Michaelis–Menten equation, and significance of Km and Vmax. Lineweaver–Burk plot. factors affecting enzyme activity such as pH, temperature, and substrate concentration.

UNIT III: Mechanism and Regulation of Enzymes

Basic theories of enzyme action: the lock and key model and the induced fit model. Introduction to enzyme inhibition. Basic concept of the regulation of enzyme activity. Enzyme inhibition: competitive, non-competitive, and uncompetitive inhibition (overview). Feedback regulation of enzyme activity

UNIT IV: Applications of Enzymes

Role of enzymes in daily life. Applications of enzymes in medicine, the food industry, and household products. Basic idea of biosensors and enzyme assays.

Lab Course: M.D/I.D (M)-IV: Enzymology

1. Study of amylase activity on starch
2. Determination of α-amylase activity in saliva
3. Effect of substrate concentration on enzyme activity
4. Effect of pH, temperature, and time on enzyme activity
5. Effect of salt concentration on enzyme activity
6. Effect of metal ions on enzyme activity (demonstration/experiment)
7. Basic enzyme inhibition study (demonstration)

Any other practical based on departmental facilities

SEMESTER – V

DSC-VII (Major) Introduction to Metabolism

Unit 1: Carbohydrate Metabolism

Overview of carbohydrate metabolism, glucose transporters, glycolysis, regulation of glycolysis, fate of pyruvate and fermentation, pyruvate dehydrogenase complex, citric acid cycle, pentose phosphate pathway, electron transport chain and oxidative phosphorylation, chemiosmotic theory and ATP synthesis, gluconeogenesis, glycogenesis and glycogenolysis, hormonal regulation of blood glucose.

Unit 2: Amino Acid Metabolism

Overview of amino acid metabolism, Digestion and absorption of proteins, mechanism of transamination and deamination, urea cycle, catabolism of amino acids, glucogenic and ketogenic amino acids, biogenic amines, inborn errors of amino acid metabolism, integration with other metabolic pathways.

Unit 3: Lipid Metabolism

Overview of lipid metabolism, Digestion and absorption of lipids, fatty acid transport to mitochondria, β-oxidation of fatty acids, fatty acid synthesis (acetyl-CoA carboxylase, fatty acid synthase, regulation), triglyceride synthesis, cholesterol biosynthesis and regulation, ketogenesis and ketolysis, eicosanoids, lipid peroxidation and oxidative stress.

Unit 4: Nucleotide Metabolism

Overview of nucleotide metabolism, ribose-5-phosphate and PRPP formation, purine and pyrimidine biosynthesis (salvage, de novo pathways), regulation of nucleotide metabolism, salvage pathways, degradation of purines and pyrimidines, disorders of nucleotide metabolism, therapeutic inhibitors.

Lab Course: DSC-VII (Major) Introduction to Metabolism

1. Estimation of carbohydrate by anthrone method
2. To perform qualitative tests for proteins (Biuret, Ninhydrin)
3. Quantitative analysis of protein using lowry method
4. To estimate reducing sugars by DNS (Dinitrosalicylic acid) method.
5. Measurement of lipid profile, total cholesterol, triglycerides, HDL, and LDL by enzymatic methods.
6. Estimation of urea in serum or urine sample.
7. Estimation of serum cholesterol by enzymatic method.
8. Estimation of creatinine in serum sample.

Any other practical as per the facility available in the department.

DSC (Major) -VIII Clinical Biochemistry

Unit I: Carbohydrate Disorders

Overview of carbohydrate disorders, Diabetes mellitus type I and type II, insulin resistance and metabolic syndrome, regulation of blood glucose (insulin, glucagon, epinephrine), glucose tolerance test, glycated hemoglobin (HbA1c), glycogen storage diseases (general overview), galactosemia and lactose intolerance, complications of diabetes (retinopathy, nephropathy and neuropathy).

Unit II: Lipid Disorders

Plasma lipoproteins (chylomicrons, VLDL, LDL, HDL) and their functions, apolipoproteins (basic role), hyperlipidemia (classification and general features), atherosclerosis and risk factors, lipid storage diseases (Gaucher's disease, Tay-Sachs disease, Niemann–Pick disease – basic idea).

Unit 3: Liver and Kidney Function

Functions of liver, liver function tests, bilirubin metabolism and types of jaundice (hemolytic, hepatic, obstructive), common liver disorders (fatty liver, cirrhosis – introductory concept), kidney function tests (urea, creatinine, uric acid), glomerular filtration rate (basic concept), electrolyte balance (sodium, potassium), acid–base balance: respiratory and renal regulation, acid–base disorders, chronic renal failure.

Unit 4: Clinical Enzymes, Blood Clotting, and Cancer

Diagnostic enzymes (SGOT, SGPT, LDH, alkaline phosphatase), isoenzymes, enzyme markers in myocardial infarction and liver disease, blood clotting mechanism (basic pathways), coagulation factors (general idea), bleeding disorders (hemophilia – basic concept), fibrinolysis (overview), introduction to cancer biology (oncogenes, tumor suppressor genes), carcinogenesis (basic factors), tumor markers (examples), cancer metabolism (Warburg effect – basic idea).

Lab Course: DSC-VIII (Major) Clinical Biochemistry

1. Estimation of blood glucose by the glucose oxidase peroxidase method (GOD–POD)
2. Determination of serum cholesterol by the enzymatic method
3. Estimation of serum bilirubin (total, direct, indirect)
4. Determination of serum SGPT (ALT) or SGOT (AST) activity
5. Estimation of serum creatinine by Jaffe's method
6. Estimation of blood urea nitrogen (BUN) or urea in serum
7. Determination of bleeding time and clotting time

Any other practical as per the facility available in the department.

DSE (Major) Elective-I Gene Expression & Regulation

Unit I: Transcription in Prokaryotes and Eukaryotes

Overview of transcription, RNA polymerase (basic structure and function), sigma factor, transcription in prokaryotes (promoter regions and stages), transcription factors (basic role), overview of eukaryotic transcription, RNA polymerases I, II and III (functions), comparison of prokaryotic and eukaryotic transcription, chromatin structure and basic concept of histone modification.

Unit 2: RNA Processing and Genetic Code

Overview of RNA processing, RNA splicing (basic mechanism), introns and exons, alternative splicing (introductory concept), 5′ capping and 3′ polyadenylation, overview of genetic code (properties), wobble hypothesis (basic idea).

Unit 3: Translation and Protein Targeting

Overview of translation, structure and role of RNA (mRNA, tRNA, rRNA), ribosome (70S and 80S – basic concept), stages of translation (initiation, elongation, termination), comparison of prokaryotic and eukaryotic translation, inhibitors of protein synthesis (basic examples), post-translational modifications (overview), protein targeting (signal peptide and basic mechanism)

Unit 4: Regulation of Gene Expression

Overview of gene regulation, operon concept (lac operon and trp operon – basic mechanism), induction and repression, induction of SOS response, chromatin organization (euchromatin and heterochromatin), epigenetic regulation (DNA methylation and histone modification – basic idea), regulatory RNAs (miRNA, siRNA – overview), RNA interference (basic concept).

DSE (Major) Elective-I Modern Molecular Tools & Techniques

Unit I: Fundamental Molecular Techniques

Overview of molecular biology techniques, basic principles of DNA and RNA isolation, nucleic acid quantification (spectrophotometry), agarose gel electrophoresis, restriction enzymes as tools in molecular biology.

Unit II: DNA Amplification and Analysis Techniques

Polymerase chain reaction (principle and steps), types of PCR (RT-PCR, qPCR – basic concept), blotting techniques (Southern, Northern, Western – principle and applications), DNA fingerprinting and its applications.

Unit III: Gene Cloning and Genome Editing

Basic steps in gene cloning, vectors (plasmids and bacteriophages), transformation methods, selection and screening, expression of recombinant proteins (overview), introduction to CRISPR-Cas9 and its applications.

Unit IV: Protein Analysis and Bioinformatics Tools

SDS-PAGE, chromatography techniques (basic principles), ELISA and immunoblotting, introduction to bioinformatics databases and tools (GenBank, PDB, BLAST), basic sequence analysis.

SEC IX Industrial visit/Internship

Industrial visit: The Industrial Visit course aims to provide students with practical exposure to real-world industrial environments, bridging the gap between theory and practice. It enhances understanding of industrial processes, workplace technologies, and professional ethics, while also developing observational skills and motivating students towards entrepreneurship.
Internship: The internship aims to bridge classroom learning with real-world experience by developing practical skills, professional ethics, and employability among students. It provides hands-on exposure to industry, research, community, or entrepreneurial settings relevant to the programme of study. Internship may be offered either under the Skill Enhancement Course (SEC) category. Accordingly, a 36-days internship shall carry 4 credits within a semester.

Minor- V Biochemistry in Health and Disease

Unit I: Inborn Errors of Carbohydrate Metabolism

Overview of carbohydrate disorders, diabetes mellitus (Type I and Type II), regulation of blood glucose (insulin and glucagon), glucose tolerance test (basic concept), glycogen storage diseases (general features), galactosemia (basic concept), hypoglycemia & hyperglycaemia (overview).

Unit II: Related Disorders in Lipid Metabolism

Overview of lipid disorders, plasma lipoproteins (chylomicrons, VLDL, LDL, HDL) and their functions, cholesterol and triglyceride metabolism (overview), hyperlipidemia (classification and general features), ketone bodies and ketoacidosis (basic concept), lipid storage diseases (Gaucher's, Tay–Sachs, Niemann–Pick – overview), atherosclerosis and risk factors.

Unit III: Liver, Kidney and Acid–Base Balance

Functions of liver (overview), liver disorders (jaundice, fatty liver, cirrhosis – basic concept), kidney disorders (renal failure – overview), kidney function (basic idea), electrolyte balance (sodium and potassium), acid–base balance, respiratory and renal regulation, acid–base disorders.

Unit IV: Clinical Enzymology, Hemostasis and Cancer

Diagnostic enzymes (AST, ALT – basic significance), enzyme markers in disease conditions (overview), blood clotting mechanism (basic pathways), hemophilia (basic concept), fibrinolysis (overview), introduction to cancer (causes and basic mechanisms), oncogenes and tumor suppressor genes, basics of cancer therapy.

SEMESTER – VI

DSC (Major)-X Outlines of Immunology

Unit I: Basics of Immunology

Overview and brief history of immunology (Jenner, Pasteur), types of immunity (innate and adaptive), humoral and cell-mediated immunity, antigens (basic concept), antibodies (types and general structure), antigen–antibody interactions (basic principles).

Unit II: Immune Cells and Lymphoid Organs

Overview of hematopoiesis (basic concept), immune cells (B cells, T cells, NK cells, macrophages, neutrophils – functions), antigen-presenting cells (basic role), primary lymphoid organs (bone marrow, thymus), secondary lymphoid organs (spleen, lymph nodes), basic concept of lymphatic system.

Unit III: Immune Responses:

Antigen processing and presentation, Major Histocompatibility Complex (Class I and II), cytokines (types and functions), complement system (pathways and functions), vaccination, immunological memory

Unit IV: Immunological Disorders and Applications:

Hypersensitivity reactions (Types I–IV), autoimmune diseases (organ-specific, systemic), immunodeficiency disorders, overview of HIV/AIDS, transplantation and graft rejection, applications of immunology (vaccines, diagnostics, immunotherapy)

Lab course : DSC (Major)-X Outlines of Immunology

1. Estimation of hemoglobin using Sahli's or cyanmethemoglobin method
2. Determination of human blood group (ABO system) by antigen–antibody agglutination reaction.
3. Estimation of total white blood cell count (WBC) using hemocytometer.
4. Preparation of peripheral blood smear (staining and identification of leukocytes).
5. Differential leukocyte count (DLC) by microscopic examination.
6. Demonstration of antigen–antibody interaction by slide and tube agglutination test.
7. Detection of C-reactive protein (CRP) by latex agglutination test.
8. Study of ELISA (enzyme-linked immunosorbent assay) for detection of antigen or antibody.

Any other practical as per the facility available in the department.

DSC (Major)-XI Biotechnology and Genetic Engineering

Unit I: Introduction to Biotechnology

Overview and history of biotechnology, scope and branches, basic tools and techniques (molecular biology and genetic engineering), applications in agriculture, medicine, industry and environment, biosafety (basic concepts), ethical issues in biotechnology (GMOs and gene editing – overview).

Unit II: Genetic Engineering and Recombinant DNA Technology

Restriction enzymes (types and functions), DNA ligase (basic role), vectors (plasmids and bacteriophages, cosmids, BAC, YAC), basic steps in gene cloning, transformation methods (heat shock and electroporation), selection and screening (antibiotic resistance, blue-white screening), polymerase chain reaction (principle and applications).

Unit III: Molecular Analysis Techniques

Blotting techniques (Southern DNA, Northern RNA, Western protein), DNA sequencing (Sanger method, next generation sequencing NGS), DNA fingerprinting.

Unit IV: Applications of Biotechnology

Recombinant proteins (insulin, vaccines), genetically modified organisms GMOs (Bt crops, golden rice), transgenic plants and animals, monoclonal antibodies (hybridoma technology), gene therapy (basics), CRISPR-Cas technology (overview), industrial biotechnology (enzyme production, fermentation), environmental biotechnology (bioremediation, waste treatment).

Lab Course: DSC-XI (Major) Biotechnology and Genetic Engineering

1. Extraction of genomic DNA from plant or bacterial sample.
2. Agarose gel electrophoresis of plasmid DNA and visualization under UV light
3. Determination of DNA concentration and purity using A260/A280 ratio.
4. Demonstration of polymerase chain reaction PCR (principle, amplification, gel analysis).
5. Isolation of RNA from plant sample by trizol/phenol chloroform extraction method
6.
7. Measurement of bacterial growth using spectrophotometer and plotting of growth curve.
8. Restriction digestion of DNA using restriction enzymes and analysis on agarose gel.
9. Isolation of plasmid DNA from bacterial cells (alkaline lysis method).

Any other practical as per the facility available in the department.

DSE (Major) Elective-II Industrial Biotechnology

Unit I: Introduction to Industrial Biotechnology

Scope and importance of industrial biotechnology, screening of microorganisms (primary screening, secondary screening), selection of industrial strains, strain improvement (mutation, recombinant methods), microbial growth kinetics (lag phase, log phase, stationary phase), sterilization techniques (dry heat, moist heat, filtration), aseptic techniques.

Unit II: Fermentation Technology

Basic principles of fermentation, types of fermentation (batch, fed-batch, continuous), bioreactors (stirred tank and airlift – basic design and function), media formulation (basic components), upstream processing (inoculum preparation – overview), downstream processing (filtration, centrifugation – basic concept).

Unit III: Industrial Production of Biomolecules

Production of industrial products (enzymes, antibiotics, organic acids, alcohols, vitamins – examples), single cell protein (basic concept), role of microorganisms in production, introduction to recombinant DNA technology for yield improvement.

Unit IV: Applications and Emerging Trends

Applications in food and dairy industry, biofuels (bioethanol, biodiesel – overview), bioplastics (basic concept), environmental biotechnology (bioremediation, waste treatment), biosafety and basic regulatory aspects in industry.

DSE (Major) Elective-II Animal Cell culture: Principle and applications

Unit I: Introduction to Animal Cell Culture

Overview and history of animal cell culture, types of cell cultures (primary and cell lines), advantages and limitations, laboratory requirements (sterile conditions and basic equipment), aseptic techniques, basic concept of biosafety levels

Unit II: Culture Media and Cell Lines

Types of culture media (natural and synthetic), role of serum and serum-free media (basic idea), primary and established cell lines (overview), maintenance of cell cultures, cryopreservation (basic concept).

Unit III: Techniques in Animal Cell Culture

Cell isolation (basic methods), subculturing (passaging), cell viability assays (basic principle), cell counting (hemocytometer), contamination (types and prevention), basic concept of cell synchronization.

Unit IV: Applications of Animal Cell Culture

Applications in vaccine production, recombinant protein production (biopharmaceuticals), monoclonal antibodies (introductory concept), toxicity testing, cancer research (cell lines), tissue engineering (basic idea), and gene therapy (overview).

SEC-XII Project Report/Community outreach project

Project Report: The Project Report course under NEP 2020 aims to cultivate research aptitude, analytical thinking, and academic writing skills among students. It provides hands-on experience in identifying problems, collecting data, and presenting findings systematically. This experiential learning component enhances subject-specific understanding, promotes interdisciplinary approaches, and prepares students for research-based higher education or professional roles in diverse fields.

Community outreach project: The curricular component of 'community outreach' will involve activities that would expose students to the socio-economic issues in society so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems.

Minor VI Basics of Biotechnology and Genetic Engineering

Unit I: Basics of Biotechnology

Overview and scope of biotechnology, applications in agriculture, medicine, industry and environment, basic tools and techniques, branches of biotechnology, biosafety and ethical issues (overview).

Unit II: Recombinant DNA Technology

Restriction enzymes (basic function), cloning vectors (plasmids and bacteriophages, cosmids, BAC, YAC), basic steps in gene cloning, transformation methods (heat shock and electroporation), selection and screening (antibiotic resistance, blue-white screening), polymerase chain reaction (principle and applications

Unit III: Molecular Analysis Techniques

Blotting techniques (Southern DNA, Northern RNA, Western protein), DNA sequencing (Sanger method, next generation sequencing NGS), DNA fingerprinting.

Unit IV: Applications of Genetic Engineering

Recombinant proteins (insulin, vaccines), genetically modified organisms GMOs (Bt crops, transgenic animals), monoclonal antibodies (hybridoma), gene therapy, CRISPR-Cas system, industrial biotechnology (enzyme production, fermentation), environmental biotechnology (bioremediation, waste treatment).

SEMESTER – VII

DSC (Major) -XIII Plant Biochemistry

Unit I: Photosynthesis and Energy Transduction

Photosynthesis: General principles and significance; structure and organization of chloroplast; photosynthetic pigments with emphasis on chlorophyll and its basic biosynthesis. Light reactions: Photosystems I and II, electron transport chain, and photophosphorylation; light energy conversion and its regulation. Introduction to carbon fixation and its relationship with light reactions.

Unit II: Carbon Fixation and Photorespiration

Carbon fixation pathways: C3 pathway (Calvin cycle) including major steps and regulation of metabolite flow; role and functional aspects of Rubisco. Light regulation of Calvin cycle. Photorespiration: pathway, significance, and its interaction with photosynthesis. Carbon concentrating mechanisms: overview of C4 and CAM pathways and their adaptive significance.

Unit III: Nitrogen and Sulphur Metabolism

Nitrate assimilation: role and basic features of nitrate reductase and nitrite reductase; ammonia assimilation through GS-GOGAT pathway; regulation of nitrogen metabolism. Sulphate assimilation: pathway leading to cysteine biosynthesis. Glutathione: structure and role in sulphur metabolism and plant stress response.

Unit IV: Secondary Metabolism, Plant Stress and Defence

Secondary metabolites: classification, basic biosynthesis, and functions of terpenes, alkaloids (with reference to nicotine), tannins, lignin, pigments, and waxes. Plant toxins: mycotoxins, protease inhibitors, and lectins. Plant stress: types of environmental stresses (salinity, drought, heat, cold, heavy metals) and their effects on plant metabolism. Plant defence mechanisms: hypersensitive response (HR), systemic acquired resistance (SAR), and induced systemic resistance (ISR). Antioxidative defence system: generation of reactive oxygen species and role of enzymatic and non-enzymatic antioxidants.

Lab Course: DSC (Major) -XIII Plant Biochemistry

1. Separation of photosynthetic pigments by paper or thin layer chromatography (TLC)
2. Estimation of chlorophyll content in plant leaves
3. Demonstration of photosynthetic oxygen evolution using aquatic plants (e.g., Hydrilla) to study the effect of light intensity on oxygen evolution.
4. Study of photorespiration (qualitative demonstration)using leaf discs or a suitable experimental setup to understand the concept of photorespiration.
5. Assay of nitrate reductase activity in plant tissues
6. Determination of proline accumulation in plants subjected to abiotic stress (e.g., salt or drought stress).
7. Estimation of antioxidant enzyme activity (Catalase or Peroxidase)

Any other practical as per the facility available in the department.

DSC (Major) –XIV Human Physiology

Unit I: Blood and Circulatory System

Composition and functions of blood; plasma and plasma proteins. Formed elements: erythrocytes (including hemoglobin), leucocytes, and thrombocytes. Blood groups and Rh factor. Blood coagulation: mechanism and regulation. Structure of heart and blood vessels; cardiac cycle and heart sounds. Regulation of blood pressure and common circulatory disorders.

Unit II: Digestive and Respiratory Systems

Digestive system: composition and functions of saliva, gastric, pancreatic, intestinal and bile secretions; digestion and absorption of carbohydrates, lipids, proteins, and nucleic acids; role of microbiota in digestion; nutritional disorders including obesity and malnutrition.
Respiratory system: structure of air passages and alveoli; pulmonary volumes; alveolar surface tension and work of breathing; exchange and transport of oxygen and carbon dioxide; oxygen and carbon dioxide dissociation curves; role of 2,3-diphosphoglycerate, Bohr effect, and chloride shift; regulation of respiration and associated disorders (asthma, COPD, respiratory acidosis and alkalosis).

Unit III: Endocrine System

Endocrine glands: structure, secretion, and functions of hormones of the pituitary, thyroid, and gonads. Mechanism of hormone action and regulation of hormonal secretion.

Unit IV: Excretory System and Homeostasis

Structure of the nephron; glomerular filtration; tubular reabsorption of glucose, water, and electrolytes; tubular secretion. Regulation of water and electrolyte balance; acid-base balance and maintenance of homeostasis.

Lab course: DSC (Major) –XIV Human Physiology

1. Determination of Blood Groups (ABO and Rh system) using standard antisera (A, B, D).
2. Estimation of Haemoglobin (Hb) concentration using Sahli's/acid hematin method or digital hemoglobinometer.
3. Total RBC and WBC Count using a hemocytometer; basic understanding of variations.
4. Measurement of Blood Pressure: Recording systolic and diastolic blood pressure using a sphygmomanometer.
5. Study of Cardiac Activity (Pulse Rate Measurement): Measurement of pulse under resting and post-exercise conditions.
6. Estimation of Salivary Amylase Activity: Demonstration of enzymatic digestion of starch under different conditions (pH/temperature).
7. Qualitative Analysis of Urine: Tests for glucose, proteins, and ketone bodies to understand renal function and disorders.

Any other practical as per the facility available in the department.

DSC (Major) –XV Biochemical and Biophysical techniques

Unit I: Electrochemistry and Electrophoretic Techniques

Electrochemistry: Ionization of water, acids and bases, buffers and buffering capacity. Determination of pH: principles and instrumentation.
Electrophoresis: Principles and separation of biomolecules using agarose and polyacrylamide gels (PAGE); native PAGE and SDS-PAGE; basic concept of isoelectric focusing and two-dimensional electrophoresis.

Unit II: Centrifugation and Chromatographic Techniques

Centrifugation: Principle of sedimentation, types of centrifuges and rotors; preparative, differential and density gradient centrifugation; applications including molecular weight determination and subcellular fractionation.
Chromatography: Principles and applications of paper chromatography, thin layer chromatography (TLC), gel filtration, ion exchange and affinity chromatography; introduction to high-performance liquid chromatography (HPLC).

Unit III: Spectroscopic and Microscopic Techniques

Basic concepts of spectroscopy; principles and applications of UV-visible spectroscopy. Introduction to NMR, ESR, Raman spectroscopy, mass spectrometry, and X-ray crystallography (basic concepts only). Microscopy: Transmission and scanning electron microscopy (TEM and SEM), freeze-fracture techniques, and staining methods for biological samples.

Unit IV: Optical Methods and Tracer Techniques

Optical methods: absorption of polarized light, optical rotatory dispersion (ORD), circular dichroism (CD), and hypochromism in relation to structure of biomolecules.
Tracer techniques: detection and measurement of isotopes; principles and applications of liquid scintillation counting, gamma counting, and autoradiography.

Lab Course: DSC (Major) –XV Biochemical and Biophysical techniques

1. Preparation of standard buffers (acetate/phosphate) and measurement of pH using pH meter; demonstration of buffering capacity.
2. Separation of amino acids by paper chromatography using suitable solvent systems and calculation of Rf values.
3. Separation of biomolecules by Thin Layer Chromatography (TLC) and visualization using appropriate reagents.
4. Gel filtration chromatography: Separation of molecules based on size using Sephadex column; determination of elution profile.
5. Ion exchange chromatography: Separation of charged biomolecules (e.g., amino acids/proteins) using ion exchange resin.
6. Demonstration of Differential centrifugation for separation of cellular components (e.g., crude cell fractionation or blood component separation).
7. Separation of DNA samples and visualization under UV light.

Any other practical as per the facility available in the department.

DSC (Major) –XVI Neurobiochemistry

Unit I: Muscle and Neuronal Structure

Muscle biochemistry: structure of skeletal muscle; contractile proteins—actin, myosin, tropomyosin, and troponin; molecular mechanism of muscle contraction; types of skeletal muscle fibers; concept of twitch and motor unit; role of calcium and calmodulin in muscle function.
Neuromorphology: structure and organization of neuron; dendrites and axons; types and functions of glial cells—astrocytes, oligodendrocytes, ependymal cells, and Schwann cells.

Unit II: Neurophysiology and Synaptic Transmission

Generation and conduction of action potential; monophasic action potential and saltatory conduction; role of myelination. Synaptic transmission: types of synapses, mechanism of neurotransmitter release and action. Overview of major neurotransmitters. Blood-brain barrier and cerebrospinal fluid (CSF): structure and functions.

Unit III: Membrane Transport Mechanisms

Transport across biological membranes: simple diffusion, facilitated diffusion, and active transport (primary and secondary). Transport ATPases and ion pumps (basic concepts). Vesicular transport: endocytosis and exocytosis. Significance of membrane transport in neuronal function.

Unit IV: Neurological Disorders and Neurodegeneration

Introduction to common neurological disorders: headache, migraine, epilepsy, multiple sclerosis, and myasthenia gravis. Neurodegenerative diseases: Parkinson's disease, Alzheimer's disease, and Huntington's disease (basic biochemical aspects). Role of neuroinflammation and oxidative stress in neurodegeneration. Basic approaches to treatment and management (overview).

Lab Course: DSC (Major) –XVI Neurobiochemistry

1. Study of Skeletal Muscle Structure (Histology Slide/Model Study).
2. Estimation of Acetylcholinesterase Activity (Demonstration/Assay).
3. Determination of Nerve Conduction Reflex (Reaction Time Test)
4. Study of Effect of Temperature on Enzyme Activity (Neural Relevance): Demonstration using enzyme assays to correlate temperature effects with nerve function.
5. Demonstration of Membrane Transport (Osmosis/Diffusion Experiment)
6. Study of diffusion and osmosis using dialysis tubing or potato osmometer as models.
7. Qualitative Estimation of Neurotransmitters or Related Metabolites (Demonstration): Basic demonstration (colorimetric/kit-based) to understand biochemical aspects of neurotransmission.

Any other practical as per the facility available in the department.

DSE (Major) Elective-III Biosafety, Laboratory safety and IPR

Unit I: Basics of Biosafety

Introduction to biosafety and its importance; basic concept of biohazards. Biological safety cabinets and primary containment. Biosafety levels (BSL-1 to BSL-4) with examples. Biosafety guidelines in India; roles of IBSC, RCGM, and GEAC (basic idea). Introduction to genetically modified organisms (GMOs) and their applications in food and agriculture. Basic concepts of risk assessment and environmental safety.

Unit II: Bioethics and Laboratory Safety

Introduction to bioethics and its importance. Ethical issues related to GMOs, cloning, stem cell research, and drug testing (basic understanding). Laboratory safety: general rules and good laboratory practices (GLP). Safe handling, storage, and disposal of chemicals and biological materials. Personal protective

equipment (PPE) and basic emergency procedures. Introduction to regulatory agencies (DBT, ICMR – basic role only).

Unit III: Introduction to Intellectual Property Rights (IPR)

Basic concepts of IPR: patents, copyright, trademarks, geographical indications, and traditional knowledge. Importance of IPR in research and innovation. Introduction to Indian Patent Act (basic idea). Simple understanding of patent filing process and precautions before publishing research. Introduction to patent databases (basic awareness).

Unit IV: Patents and Research Applications

Basic steps in patent filing: provisional and complete specifications (concept only). Introduction to international patenting (PCT – basic idea). Patent publication and simple understanding of infringement. Case studies: turmeric, neem, and basmati rice patents. Role of IPR in protecting research and traditional knowledge.

Lab Course: DSE (Major) Elective-III Biosafety, Laboratory safety and IPR

1. Preparation of a report/diagram illustrating BSL-1 to BSL-4 laboratories, their features, and applications.
2. Demonstration and documentation of different Personal Protective Equipment (PPE) used in laboratories; proper usage and safety significance.
3. Preparation of Standard Operating Procedure **(SOP)** for handling biological samples or hazardous chemicals in a laboratory.
4. Analysis of ethical issues related to GMOs, cloning, stem cell research, or clinical trials; written report or presentation.
5. Patent Search Exercise: Searching patents from databases (e.g., Indian Patent Office/Google Patents) and preparing a brief report on a selected patent.
6. Preparation of a simplified patent document including title, abstract, claims, and description for a hypothetical biological invention.
7. Study and presentation of cases such as turmeric, neem, or basmati rice patents, highlighting IPR issues and outcomes.

Any other practical as per the facility available in the department.

DSE (Major) Elective –III Basics of plant tissue culture

Unit I: Introduction and Laboratory Setup

Concept, history, and significance of plant tissue culture. Totipotency and differentiation. Types of culture: callus culture, suspension culture, organ culture, and meristem culture (basic concepts). Infrastructure and organization of a tissue culture laboratory. Sterilization techniques: dry heat, moist heat, filtration. Aseptic techniques and contamination control.

Unit II: Culture Media and Growth Conditions

Composition of culture media: macro- and micronutrients, vitamins, carbon sources, and growth regulators (auxins and cytokinins). Preparation of culture media (Murashige and Skoog medium – basic idea). Role of plant growth regulators in morphogenesis. Physical factors affecting growth: light, temperature, pH, and humidity.

Unit III: Plant Regeneration and Micropropagation

Stages of micropropagation: initiation, multiplication, rooting, and hardening. Callus induction and organogenesis (shoot and root formation). Somatic embryogenesis (basic concept). Applications of plant tissue culture: clonal propagation, germplasm conservation, production of disease-free plants.

Unit IV: Applications and Advanced Aspects

Introduction to haploid production, protoplast culture, and somatic hybridization (basic concepts). Secondary metabolite production using tissue culture. Synthetic seeds (basic idea). Cryopreservation (introductory concept). Role of tissue culture in crop improvement and biotechnology.

Lab Course: DSE (Major) Elective –III Basics of plant tissue culture

1. Preparation of Culture Media (MS medium)
2. Sterilisation Techniques in Tissue Culture: Surface sterilisation of explants and demonstration of aseptic handling.
3. Inoculation of Explants under Laminar Airflow: Transfer of plant material (e.g., leaf/nodal segment) to culture medium.
4. Callus Induction from Plant Explants: Observation and recording of callus formation under suitable conditions.
5. Micropropagation (Shoot Multiplication): Subculturing and observation of shoot proliferation.
6. Root Induction and Hardening of Plantlets: Transfer of shoots to rooting medium and acclimatisation of plantlets.
7. Study of Contamination and Its Control: Identification of fungal/bacterial contamination and preventive measures.

Any other practical as per the facility available in the department.

(Minor)–VII Or M.D/I.D. (M)-V Fundamentals of Plant Biochemistry

Unit I: Basics of Photosynthesis and Plant Cell Organization

Introduction to plant biochemistry and its significance. Structure and organization of plant cell and chloroplast. Photosynthetic pigments: chlorophyll and accessory pigments. Basic concept of photosynthesis; light reactions: Photosystems I and II, electron transport chain, and photophosphorylation (introductory level). Overview of carbon fixation and its relationship with light reactions.

Unit II: Carbon Assimilation and Photorespiration

Carbon fixation: C3 pathway (Calvin cycle) – major steps and importance. Role of Rubisco (basic concept). Introduction to photorespiration and its significance. Overview of C4 and CAM pathways and their adaptive importance. Simple regulation of photosynthesis.

Unit III: Plant Nitrogen and Sulphur Metabolism

Introduction to nitrogen metabolism in plants. Nitrate assimilation: role of nitrate reductase and nitrite reductase. Ammonia assimilation (GS-GOGAT pathway – basic concept). Sulphur metabolism: sulphate assimilation and cysteine formation. Role of glutathione in plant metabolism and stress tolerance.

Unit IV: Secondary Metabolites and Plant Stress

Introduction to primary and secondary metabolites. Classification and functions of secondary metabolites: terpenes, alkaloids, tannins, pigments, lignin, and waxes. Plant stress: types (biotic and abiotic) and their effects on plant metabolism. Basic plant defence mechanisms. Role of reactive oxygen species (ROS) and antioxidative defence system (enzymatic and non-enzymatic).

Lab Course: (Minor)–VII Or M.D/I.D. (M)-V Fundamentals of Plant Biochemistry

1. Separation of photosynthetic pigments by paper or thin layer chromatography (TLC)
2. Spectrophotometric estimation of chlorophyll content in plant leaves of chlorophyll a and b.
3. Demonstration of photosynthetic oxygen evolution using aquatic plants (e.g., Hydrilla) to study the effect of light intensity.
4. Demonstration of osmosis and diffusion in plant systems: Using potato osmometer or dialysis tubing.
5. Assay of nitrate reductase activity:Estimation of enzyme activity in plant tissues.
6. Estimation of proline under stress conditions.
7. Estimation of catalase or peroxidase antioxidant enzyme activity in plants.

Any other practical as per the facility available in the department.

Semester VIII

DSC (Major) -XVII: Advanced Metabolism

Unit I: Bioenergetics and Integration of Metabolism

Concepts of bioenergetics: free energy, high-energy compounds, and ATP cycle. Regulation of metabolic pathways: allosteric regulation, covalent modification, and hormonal control. Integration of carbohydrate, lipid, and amino acid metabolism during fed and fasting states. Metabolic adaptations in starvation, diabetes, and exercise. Role of major metabolic organs: liver, muscle, and adipose tissue.

Unit II: Regulation of Carbohydrate and Lipid Metabolism

Regulation of glycolysis, gluconeogenesis, and TCA cycle (key regulatory steps). Cori cycle and glucose-alanine cycle. Glycogen storage disorders (overview). Regulation of β-oxidation and fatty acid synthesis. Regulation of cholesterol synthesis and transport. Lipoprotein metabolism and associated disorders (atherosclerosis – basic concept). Metabolic role of ketone bodies during fasting.

Unit III: Amino Acid and Nitrogen Metabolism

Regulation of amino acid metabolism and nitrogen balance. Inter-organ transport of nitrogen (glutamine and glucose-alanine cycle). Regulation of urea cycle. Integration of amino acid metabolism with central metabolic pathways. Disorders of amino acid metabolism (phenylketonuria, alkaptonuria – overview). One-carbon metabolism and its significance.

Unit IV: Nucleotide Metabolism and Metabolic Disorders

Regulation of purine and pyrimidine biosynthesis. Salvage pathways and their importance. Disorders of nucleotide metabolism (gout, Lesch–Nyhan syndrome – overview). Biochemical basis of metabolic diseases: diabetes mellitus, obesity, and metabolic syndrome. Introduction to molecular regulation of metabolism (hormones and signaling pathways – overview). Therapeutic approaches targeting metabolic pathways.

Lab Course: DSC (Major) -XVII: Advanced Metabolism

1. Determination of glucose concentration using GOD-POD/kit method; interpretation under normal and diabetic conditions.
2. Study of glucose utilization and interpretation of tolerance curves (normal vs diabetic). Determination of total cholesterol using enzymatic/colorimetric method.
3. Measurement of serum triglyceride levels and interpretation in metabolic disorders.
4. Separation of Lipoproteins (Demonstration/TLC-based approach)**:** Basic understanding of HDL, LDL, and VLDL separation and significance.
5. Estimation of urea concentration to understand nitrogen metabolism and kidney function.
6. Determination of creatinine levels and their relevance to muscle metabolism and renal function.
7. Measurement of enzyme kinetics under varying conditions (pH/temperature) to understand metabolic regulation.
8. Qualitative Analysis of Ketone Bodies in Urine**:** Detection of ketone bodies and correlation with fasting/starvation or diabetes.

Any other practical as per the facility available in the department.

DSC (Major) -XVIII Nutritional Biochemistry

Unit I: Fundamentals of Nutrition and Energy Metabolism

Overview of macronutrients and micronutrients and their functions. Dietary fibres and their physiological significance. Energy content of foods and concept of energy balance. Measurement of energy expenditure: direct and indirect calorimetry (basic concept). Basal Metabolic Rate (BMR), Specific Dynamic Action (SDA), and factors affecting them. Thermogenic effect of food. Role of gut microbiota in nutrition and metabolism.

Unit II: Food Components, Antinutrients and Additives

Naturally occurring food toxicants and antinutrients: protease inhibitors, hemagglutinins, oxalates, allergens, and toxins from plant and animal foods (basic concept). Food additives: antioxidants, antimicrobial agents, sweeteners, stabilizers, and thickeners. Introduction to genetically modified foods and their nutritional implications.

Unit III: Malnutrition and Metabolic Disorders

Protein-energy malnutrition (PEM): marasmus and kwashiorkor—causes, symptoms, and prevention. Starvation and metabolic adaptations (basic concept). Nutritional requirements across different life stages. Introduction to metabolic disorders: obesity, insulin resistance, diabetes, and cardiovascular diseases.

Unit IV: Clinical Nutrition and Health Management

Role of nutrition in disease prevention and health promotion. Diet in common disorders: dental caries, renal disorders, hyperlipidemia, and atherosclerosis (basic concept). Inherited metabolic disorders: phenylketonuria, gout (introductory idea). Functional foods and nutraceuticals. Nutritive value of common Indian foods (cereals, pulses, millets, nuts, and animal foods). Impact of modern dietary patterns and processed foods on health.

Lab Course: DSC (Major) -XVIII Nutritional Biochemistry

1. Estimation of Energy Content of Food (Calorimetry Demonstration): Determination of calorific value using simple calorimetric methods.
2. Estimation of Carbohydrates in Food Samples Using the anthrone or DNS method.
3. Estimation of Proteins in Food Samples Using the Lowry or Biuret Method.
4. Estimation of Lipids in Food Samples using Simple Solvent Methods.
5. Qualitative Tests for Food Adulteration: Detection of adulterants in milk, oils, or spices.
6. Estimation of Vitamin C in Food Samples using the titrimetric method (e.g., DCPIP method).
7. Dietary Survey and Nutritional Assessment: Preparation and analysis of a balanced diet chart for different age groups.

Any other practical as per the facility available in the department.

DSC (Major) –XIX Bio-membranes and Bioenergetics

Unit I: Structure and Composition of Biomembranes

Structure and organization of biological membranes; fluid mosaic model. Composition of membranes: lipids (phospholipids, glycolipids, cholesterol), proteins, and carbohydrates. Membrane asymmetry and fluidity; factors affecting membrane fluidity. Functions of biomembranes

Unit II: Membrane Transport Mechanisms

Transport across membranes: simple diffusion, facilitated diffusion, and active transport. Ion channels and transporters (basic concepts). Primary and secondary active transport. Vesicular transport: endocytosis and exocytosis. Role of membranes in cell communication and signaling (introductory concept).

Unit III: Bioenergetics and Energy Transformations

Concept of bioenergetics; laws of thermodynamics in biological systems. Free energy, exergonic and endergonic reactions, high-energy compounds (ATP). Redox reactions and role of coenzymes (NAD^+, FAD). Energy coupling in metabolism.

Unit IV: Oxidative Phosphorylation and Photosynthetic Energy

Electron transport chain and oxidative phosphorylation (basic concept). Chemiosmotic theory and ATP synthesis. Mitochondrial structure and its role in energy production. Introduction to photophosphorylation in plants. Regulation of energy production and concept of metabolic efficiency.

Lab Course: DSC (Major) –XIX Bio-membranes and Bioenergetics

1. Demonstration of Osmosis using Plant Cells (Potato Osmometer): Study of osmotic movement across semipermeable membranes.
2. Effect of Temperature on Membrane Permeability: Using beetroot pigment leakage to study membrane damage.
3. Study of Diffusion and Facilitated Diffusion: Demonstration using dialysis tubing.
4. Estimation of Inorganic Phosphate (Pi): To understand ATP hydrolysis and energy metabolism.
5. Isolation of Mitochondria (Demonstration): From plant/animal tissue (if feasible) or virtual demonstration.
6. Study of Diffusion using Agar Gel or Ink in Water: Demonstration of diffusion rate and factors affecting it.
7. Qualitative Test for Reducing Sugars (Benedict's Test): Understanding energy-yielding molecules in metabolism.

Any other practical as per the facility available in the department.

DSC (Major) –XX : Cancer pathogeneses and therapy

Unit I: Introduction, Causes and Classification of Cancer

Definition and basic characteristics of cancer. Causes and risk factors (genetic, environmental, lifestyle). Global and Indian cancer scenario (overview). Classification of cancers (based on tissue origin). Genetic aspects: sporadic and familial cancers (basic idea). Introduction to cellular hallmarks of cancer.

Unit II: Cancer Development and Progression

Basic concepts of oncogenes and tumor suppressor genes. Cellular transformation and regulation of normal cell growth. Cancer cell proliferation and cell cycle regulation (introductory concept). Apoptosis and its role in cancer. Basic concepts of invasion, angiogenesis, and metastasis.

Unit III: Molecular Basis of Cancer

Introduction to genetic and epigenetic changes in cancer: DNA mutations, methylation, and histone modification (basic concepts). Role of microRNAs (introductory idea). Overview of major signaling pathways involved in cancer (TP53, MAPK, PI3K-Akt – simplified). Concept of tumor heterogeneity.

Unit IV: Cancer Diagnosis and Treatment

Basic diagnostic techniques: biopsy, imaging (CT, MRI), and screening methods (Pap smear, mammography). Overview of cancer therapies: surgery, chemotherapy, and radiotherapy. Introduction to targeted therapy and immunotherapy (basic concepts). Emerging approaches: nanomedicine and cell-based therapies (introductory idea).

Lab Course: DSC (Major) –XX : Cancer pathogeneses and therapy

1. Study of Normal vs Cancer Cells (Slides/Images): Identification of morphological differences.
2. DNA Isolation from Plant/Animal Tissue: Basic technique to understand genetic basis of cancer.
3. Estimation of DNA/RNA Concentration (UV Method): Understanding nucleic acid quantification.
4. Agarose Gel Electrophoresis (Demonstration): Separation of DNA fragments.
5. Case Study Analysis of Cancer Types: Study of breast, lung, or colon cancer.
6. Survey on Cancer Risk Factors: Collection and analysis of lifestyle-related data.
7. Study of Antioxidants in Cancer Prevention (Simple Assay): Demonstration of free radical scavenging activity.

Any other practical as per the facility available in the department.

DSE (Major) Elective –IV Applied Microbiology

Unit I: Introduction to Applied Microbiology

Scope and importance of applied microbiology. Microorganisms of industrial, medical, and environmental importance (bacteria, fungi, yeast). Microbial growth and factors affecting growth (temperature, pH, oxygen, nutrients). Sterilization and disinfection methods: physical and chemical methods.

Unit II: Industrial Microbiology

Principles of industrial microbiology. Fermentation: types (batch, fed-batch, continuous – basic idea). Production of industrial products: alcohol (ethanol), organic acids (citric acid), antibiotics (penicillin), enzymes. Role of microorganisms in food production (bread, curd, cheese). Downstream processing (basic concept).

Unit III: Environmental and Agricultural Microbiology

Role of microorganisms in environment: biogeochemical cycles (carbon and nitrogen cycles). Waste management: sewage treatment (primary, secondary treatment – basic concept). Bioremediation and biodegradation. Microbes in agriculture: biofertilizers, biopesticides, nitrogen fixation.

Unit IV: Medical and Food Microbiology

Microorganisms in human health and disease (basic idea). Pathogens and transmission (overview). Food microbiology: food spoilage and food preservation methods. Probiotics and their health benefits. Basic concept of vaccines and antibiotics.

Lab Course: DSE (Major) Elective –IV Applied Microbiology

1. Preparation and sterilization of Culture Media (Nutrient Agar/Broth).
2. Sterilization Techniques: Demonstration of autoclave, hot air oven, and filtration.
3. Isolation of Microorganisms by Streak Plate Method Obtaining pure cultures.
4. Gram Staining of Gram-positive and Gram-negative bacteria.
5. Study of Microbial Growth Curve (Demonstration): Understanding phases of growth.
6. Fermentation Experiment (Yeast Fermentation): Demonstration of CO_2 production during fermentation.
7. Water Quality Analysis (Simple Microbial Test): Detection of coliform bacteria (MPN method – demonstration/basic).

Any other practical as per the facility available in the department.

DSE (Major) Elective –IV Introduction to Biostatistics

Unit I: Basics of Biostatistics and Data Presentation

Definition, scope, and importance of biostatistics in biological sciences. Types of data: qualitative and quantitative. Collection of data: primary and secondary sources. Classification and tabulation of data. Graphical representation: bar diagrams, histograms, pie charts, and frequency polygons.

Unit II: Measures of Central Tendency and Dispersion

Measures of central tendency: mean, median, and mode. Measures of dispersion: range, variance, standard deviation, and coefficient of variation. Concept of normal distribution (basic idea) and its significance in biology.

Unit III: Probability and Hypothesis Testing

Basic concepts of probability and probability distributions (binomial and normal – introductory). Hypothesis testing: null and alternative hypothesis, level of significance, p-value (basic idea). Tests of significance: t-test and chi-square test (concept and simple applications).

Unit IV: Correlation, Regression and Applications

Correlation: types and methods (Pearson's correlation coefficient – basic concept). Regression analysis (introductory idea). Applications of biostatistics in biology, medicine, and public health. Introduction to statistical software (MS Excel or similar tools).

Lab Course: DSE (Major) Elective –IV Introduction to Biostatistics

1. **Data** Classification and Tabulation**:** Preparation of frequency tables from given data.
2. Graphical Representation of Data: Drawing bar diagrams, histograms, and pie charts using graph paper or Excel.
3. Calculation of Mean, Median, and Mode from grouped and ungrouped data.
4. Calculation of Standard Deviation and Variance: Understanding variability in biological data.
5. Simple Probability Problems: Solving basic probability questions.
6. Application of t-test (Simple Dataset) **:**Comparison of two sample means.

7. Calculation of Correlation Coefficient: Determination and interpretation of correlation between variables.

Any other practical as per the facility available in the department.

(Minor)–VIII Or M.D/I.D. (M)-VI Basics of Nutritional Biochemistry

Unit I: Basic Concepts of Nutrition

Introduction to nutritional biochemistry and its importance. Macronutrients (carbohydrates, proteins, lipids) and micronutrients (vitamins and minerals): classification and functions. Dietary fibres and their physiological role. Energy content of foods and concept of balanced diet. Basic idea of energy balance. Basal Metabolic Rate (BMR) and factors affecting it (introductory concept).

Unit II: Food Components and Additives

Naturally occurring food components and antinutrients: protease inhibitors, oxalates, and allergens (basic idea). Food additives: preservatives, antioxidants, sweeteners, and colourants (introductory concept). Food adulteration: common adulterants in food. Introduction to processed foods and their impact on health.

Unit III: Malnutrition and Nutritional Requirements

Malnutrition: causes and types. Protein-energy malnutrition (marasmus and kwashiorkor): symptoms and prevention. Nutritional requirements for different age groups (children, adults, elderly). Role of diet in maintaining health. Introduction to common metabolic disorders: obesity and diabetes (basic concept).

Unit IV: Nutrition and Health

Role of nutrition in disease prevention. Diet in common conditions: dental caries, cardiovascular diseases, and obesity (basic idea). Introduction to functional foods and nutraceuticals. Nutritive value of common Indian foods: cereals, pulses, millets, fruits, vegetables, and animal foods. Concept of healthy dietary practices and lifestyle.

Lab Course: (Minor)–VIII Or M.D/I.D. (M)-VI Basics of Nutritional Biochemistry

1. Estimation of Carbohydrates in Food Samples
1. Using anthrone or DNS method.
2. Estimation of Proteins in Food Samples Using Biuret or Lowry method.
3. Estimation of Lipids in Food Samples Using simple solvent extraction method.
4. Estimation of Vitamin C in Food Samples Using titration method (DCPIP).
5. Qualitative Tests for Food Adulteration: Detection of adulterants in milk, oils, and spices.
6. Preparation of Balanced Diet Chart For different age groups based on nutritional requirements.
7. Determination of Energy Value of Food (Demonstration) simple calorimetric method to estimate energy content.

Any other practical as per the facility available in the department.

DSC (Major)- XVI Research Methodology

Unit I: Computer Applications and Information Resources in Biology

Basic introduction to the use of computers in biology. Spreadsheet tools (e.g., MS Excel): data entry, simple formulas, basic data analysis, and preparation of charts/graphs. Presentation tools (e.g., PowerPoint): preparation and delivery of simple presentations. Introduction to the Internet, use of search engines, and basic awareness of biological databases and online scientific resources.

Unit II: Fundamentals of Research Methodology

Meaning and objectives of research. Types of research: basic and applied (introductory level). Identification and formulation of simple research problems. Basic concepts of research methods (descriptive and experimental). Introduction to hypothesis and its importance. Types and sources of information: primary and secondary. Overview of the research process and simple planning of a study.

Unit III: Scientific Writing and Communication

Introduction to scientific writing. Types of scientific documents: research articles and review articles (basic understanding). Structure of a research paper using the IMRAD format (Introduction, Methods, Results, Discussion). Writing of simple abstracts and references. Importance of scientific communication and ethics in publishing.

Unit IV: Presentation and Publication of Research

Basic preparation of research reports and papers. Introduction to formatting of manuscripts (title, abstract, keywords, figures, and tables). Preparation of posters for academic presentations. Basics of oral presentation skills. Brief introduction to research funding and simple idea of proposal writing.

DSC-(Major)-XVIII Dissertation

The Dissertation/Project Work for undergraduate (UG) students shall be designed to introduce them to basic research practices and independent learning. It will be undertaken over a minimum period of three months with appropriate credit allocation. The work may involve a simple experimental study, field-based investigation, or a structured review of relevant literature, supported by basic data collection and analysis using standard methodologies.

The study is expected to demonstrate the student's understanding of the subject, ability to analyse information, and present findings in a clear and organised manner. Emphasis will be placed on developing skills such as scientific writing, data interpretation, and critical thinking.

Evaluation shall be carried out through internal and external assessment based on the written report, presentation, and viva voce.