SANTOSH
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Curriculum for

M.Sc. Medical Biochemistry

SANTOSH DEEMED TO BE UNIVERSITY
REGISTRAR
GHAZIABAD

Curriculum updating and adoption of innovative pedagogy are major components of academic excellence aimed at providing exposure to cutting edge technological advancements.

Introduction

Seeds of the current fruits of modern biology, such as genomics, metabolomics, proteomics so on, were sown during previous century in the form of interdisciplinary collaborations among basic science disciplines contributing to landmark technological innovations. One of the basic science disciplines which lead to biotechnological advancement is Biochemistry, a hybrid of biology and chemistry. Considering its pivotal role in biological sciences, it is imperative to strengthen the fundamental concepts of biochemistry at Postgraduate level with clear and tangible pedagogical approaches.

I. The present curriculum for M.Sc. Biochemistry has been prepared with the objective of providing comprehensive knowledge of biochemistry including biochemical mechanistic basis of genetic and physiological processes, metabolism under normal and pathological conditions, drug discovery and drug design, and clinical research. Apart from its traditional approach of providing more weightage to metabolism and molecular physiological aspects, the curriculum has greater emphasis on recent advancement in techniques of biochemistry and molecular biology which enable the students to better understand the core biochemistry and the offshoots such as genomics, metabolomics, proteomics, and bioinformatics. It is hoped, that during the three year program, typical attributes of a competent science postgraduate such as; spirit of inquiry, critical thinking, problem solving, analytical and scientific reasoning, research/industry related skills are discovered and nurtured.

II. Introduction to CBCS (Choice Based Credit System) Choice Based Credit System: The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill-based courses. The courses will be evaluated following the grading system, which is considered to be better than the conventional marks system. Grading system provides uniformity in the evaluation and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, which enables the student to move across institutions of higher learning. The uniformity in evaluation system also enables the potential employers in assessing the performance of the candidates.

Definitions:

(i) 'Academic Programme' means an entire course of study comprising its programme structure, course details, evaluation schemes etc. designed to be taught and evaluated in a teaching Department/Centre or jointly under more than one such Department/ Centre

(ii) 'Course' means a segment of a subject that is part of an Academic Programme

(iii) 'Programme Structure' means a list of courses (Core, Elective, Open Elective) that makes up an Academic Programme, specifying the syllabus, Credits, hours of teaching, evaluation and examination schemes, minimum number of credits required for successful completion of the programme etc. prepared in conformity to University Rules, eligibility criteria for admission

(iv) 'Core Course' means a course that a student admitted to a particular programme must successfully complete to receive the degree and which cannot be substituted by any other course

(v) 'Elective Course' means an optional course to be selected by a student out of such courses offered in the same or any other Department/Centre

(vi) 'Open Elective' means an elective course which is available for students of all programmes, including students of same department. Students of other Department will opt for these courses subject to fulfilling of eligibility of criteria as laid down by the Department offering the course.

(vii) 'Credit' means the value assigned to a course which indicates the level of instruction; One-hour lecture per week equals 1 Credit, 2 hours practical class per week equals 1 credit. Credit for a practical could be proposed as part of a course or as a separate practical course

(viii) 'SGPA' means Semester Grade Point Average calculated for individual semester.

Programme Objectives (POs):

A three-year program will lead to the award of a M.Sc. degree in Biochemistry and Biotechnology. Students will be offered advanced level theory and practical courses in subjects like proteins, cell biology, immunology and immune techniques, enzymes and their biotechnological applications, molecular biology, recombinant DNA technology and applications in biotechnology, developmental biology, proteomics and metabolomics and advanced techniques in genomics. The emphasis is on training students for research. This includes work by second-year students in research laboratories to carry out projects under the supervision of faculty members in addition to two practical courses in the first year. Before students initiate dissertation research projects, they will also be trained adequately in the various basic tools, techniques and instrumentation in specific research laboratories. Students are also required to present critical reviews on various current and significant topics in seminars for evaluation in the first year. In the second year, they present seminars on assigned research topics. In the third year, the dissertation works is completed and presented to the department . In the process they develop oratory and writing skills. In keeping with the objectives of the department, elective courses have also been included to impart knowledge in infectious diseases and life style disorders, in intermediary metabolism and advanced techniques in biochemistry. The department also offers a basic course in biochemistry for interested students across the University with background in life sciences. The department strives to achieve the following programme objectives:

- The foremost objective of the programme is to empower students with clear understanding of the basic concepts of biochemistry and provide them knowledge of the recent advances so that they can independently assess the vast scope in the field.
- The programme aims to train students to enable them to apply biochemical principles, theoretically and experimentally, to understand various complex life processes, while providing biotechnological solutions to combat various human diseases.
- It is expected that at the time of completion of the programme each student is confident and independent in their thought processes and can make an informed choice about their subsequent career.
- The program is expected to motivate students for higher education, especially research and provide trained manpower for biotechnology industry.
- They are expected to be ethically sound and ready for the next phase of their development, skilled in the art of self-reading, oration and scientific writing

Programme Specific Outcomes (PSOs):

A post-graduate student upon completion of the programme is expected to gain the following attributes:

- In-depth knowledge of Biochemistry with inter-disciplinary perspective of other branches of life sciences.
- Competence for research and innovation in Biochemistry and Biotechnology as a skilled experimentalist.
- Analytical and problem solving skills with regard to biochemical principles of life processes and technologies for combating human diseases.
- Critical thinking about the concepts in Biochemistry and ability to critically review scientific literature for development of new theories and testable hypothesis.
- Capacity for decision making with regard to scientific progress, personal development and career choice.
- Ability to work independently, while still promoting team work and collaboration skills.
- Oratory (public speaking), scientific conversation and writing skills.
- Leadership and organizational skills.
- Demonstration of integrity, honesty, ethical behavior and sense of responsibility.
- Appreciation of diversity in scientific community and responsibility towards society and nation.
- Environmental awareness vis-à-vis bio-waste generation, disposal and management and safety and security issues

MEMBERS FOR THE CURRICULUM REVISION COMMITTEE

Members:

DrJuhi Aggarwal,
Professor & Head,
Department of biochemistry,
SMCH, SDTU

Dr Jyoti Batra,
Professor & Dean Research,
Department of biochemistry,
SMCH, SDTU

Dr Raj Narayan Gupta,
Associate Professor ,
Department of biochemistry,
SMCH, SDTU

Dr Eram Hussain Pasha
Assistant Professor,
Department of biochemistry,
SMCH, SDTU

Dr Luna Sinha
Assistant Professor,
Department of biochemistry,
SMCH, SDTU

Sem.	Course code	Course type	Title of the Course	Hours per Week				Course Credit
				L *	T *	P *	Total	
I	Office Use	DSCC-I	Anatomy	4			4	4
I	Office Use	DSCC-II	Biochemistry – I	4			4	4
I	Office Use	DSEC-I	Pharmaceutical Biochemistry and Toxicology	3			3	3
I	Office Use	DSCP-I	Anatomy			4	4	2
I	Office Use	DSCP-II	Biochemistry – I			4	4	2
I	Office Use	DSEP-I	Pharmaceutical Biochemistry and Toxicology			4	4	2
I	Office Use	CP-I	Clinical Practice- Hospital lab				8	--
I	Office Use	TLR-I	Seminar/ journal club /Group Discussion				3	--
TOTAL							**34**	**17**
II	Office Use	DSCC-III	Physiology	4			4	4
II	Office Use	DSCC-IV	Biochemistry-II	4			4	4
II	Office Use	DSEC-II	Advanced Endocrinology	3			3	3
II	Office Use	DSCP-III	Physiology			4	4	2
II	Office Use	DSCP-IV	Biochemistry-II			4	4	2
II	Office Use	DSEP-II	Advanced Endocrinology			4	4	2
II	Office Use	CP-II	Clinical Practice- Hospital lab				8	--

II	Office Use	TLR-II	Seminar / journal club /Group Discussion				3	--
TOTAL							**34**	**17**
III	Office Use	DSCC-V	Hematology & Clinical Pathology	4			4	4
III	Office Use	DSCC-VI	Biochemistry – III	4			4	4
III	Office Use	DSEC-III	Microbial biochemistry	3			3	3
III	Office Use	GEC-I	Biostatistics				3	3
III	Office Use	DSCP-V	Hematology & Clinical Pathology			4	4	2
III	Office Use	DSCP-VI	Biochemistry – III			4	4	2
III	Office Use	DSEP-III	Microbial biochemistry			4	4	2
III	Office Use	PD-I	Project Work / Dissertation-DRC				4	--
III	Office Use	CP-III	Clinical Practice-Hospital Lab				4	--
TOTAL							**34**	**20**
IV	Office Use	DSCC-VII	Molecular Biology & Medical genetics	4			4	4
IV	Office Use	DSCC-VIII	Nutrition & Dietetics	4			4	4
IV	Office Use	DSEC-IV	Hereditary Metabolic System	3			3	3
IV	Office Use	GEC-II	GLP				3	3
IV	Office Use	DSCP-VII	Molecular Biology & Medical genetics			4	4	2
IV	Office Use	DSCP-VIII	Nutrition & Dietetics			4	4	2

IV	Office Use	DSEP-IV	Hereditary Metabolic System			4	4	2
IV	Office Use	PD-I	Project Work / Dissertation				4	--
IV	Office Use	CP-IV	Clinical Practice-Hospital Posting				4	--
TOTAL							**34**	**20**
V	Office Use	DSCC-IX	Immunology	4			4	4
V	Office Use	DSCC-X	Biotechnology	4			4	4
V	Office Use	DSEC-V	Neurochemistry	3			3	3
V	Office Use	SEC-I	<SWAYAM / MOOCS / NPTEL / Institution offered Skill courses>- Basics of computer and IT skills, data analysis, Personality development etc (Any one)				2	2
V	Office Use	GEC-III	Basic of NABL Accreditation				3	3
V	Office Use	DSCP-IX	Immunology			4	4	2
V	Office Use	DSCP-X	Biotechnology			4	4	2
V	Office Use	DSEP-V	Neurochemistry			4	4	2
V	Office Use	PD-I	Project Work / Dissertation				6	--
TOTAL							**34**	**22**
VI	Office Use	DSCC-XI	Cancer Biology	4			4	4
VI	Office Use	DSCC-XII	Specialized tissue Biochemistry	4			4	4
VI	Office Use	DSEC-VI	Advanced Immunology	3			3	3

VI	Office Use	SEC-II	<SWAYAM / MOOCS / NPTEL / Institution offered Skill courses> BLS & ACLS [AHA Certified]				2	2
VI	Office Use	GEC-IV	BMW				3	3
VI	Office Use	DSCP-XI	Cancer Biology			4	4	2
VI	Office Use	DSCP-XII	Specialized tissue Biochemistry			4	4	2
VI	Office Use	DSEP-VI	Advanced Immunology			4	4	2
VI	Office Use	PD-I	Project Work / Dissertation				6	12
TOTAL							**34**	**34**

L* - Lecture **T* - Tutorial** **P* - Practical**

DSCC – Discipline Specific Core Course - A Total of 12 Core courses required to be identified

DSCP – Discipline Specific Core Practical- Practical component of the respective Core Courses of the programme

DSEC – Discipline Specific Elective Course- a Pool of 8 - 10 Courses are to be identified and submitted with the Syllabi [These courses will be opted by the students of your discipline only]

DSEP – Discipline Specific Elective Practical- Practical component of the respective Elective Course selected by the students

GEC – Generic Elective Course -A pool of 6 papers required to be identified and submitted with the Syllabi [These courses will be opted by the students of Other Programme]

Title of the course: MSc (medical biochemistry)

Total Hours: Total Hours: 120 hours Theory- 60 hours

Practical- 60 hours

SEMESTER 1

Course Type: DSCC-I ANATOMY

Course Objectives:

1. Understand the Fundamentals: Explain the fundamental concepts of anatomy, including its subdivisions, anatomical terminology, and the levels of structural organization in the human body.
2. Analyze Upper Limb and Thorax Anatomy: Identify and describe the bones, joints, muscles, and nerves of the upper limb. Analyze the anatomy of the pectoral girdle, shoulder joint, axilla, brachial plexus, cubital fossa, thoracic cage, heart, and major blood vessels.
3. Explore Lower Limb and Abdomen Anatomy: Examine the bones, joints, muscles, and nerves of the lower limb. Evaluate the anatomy of the hip joint, knee joint, ankle joint, inguinal region, femoral triangle, abdominal wall layers, inguinal canal, and abdominal organs with their vasculature.
4. Examine Head and Neck Structures: Investigate the bones, joints, muscles, and nerves of the head and neck. Analyze the anatomy of the skull, cranial fossae, face, oral cavity, pharynx, neck regions, cervical plexus, major blood vessels, and nerves of the head and neck.
5. Comprehend Central Nervous System and Spinal Cord: Comprehend the structure and function of the brain's major divisions, including the cranial nerves. Describe the anatomy of the spinal cord, spinal tracts, cerebrospinal fluid circulation, ventricular system, and meninges.

Unit 1: Introduction to Anatomy

Definition of Anatomy and its subdivisions, Anatomical terminology, Basic concepts of cells, tissues, and organs, Levels of structural organization in the human body

Unit 2: Upper Limb and Thorax

Bones, joints, muscles, and nerves of the upper limb, Anatomy of the pectoral girdle and shoulder joint, Anatomy of the axilla, brachial plexus, and cubital fossa, Thoracic cage and its components, Anatomy of the heart and major blood vessels

Unit 3: Lower Limb and Abdomen

Bones, joints, muscles, and nerves of the lower limb, Anatomy of the hip joint, knee joint, and ankle joint, Anatomy of the inguinal region and femoral triangle, Abdominal wall layers and inguinal canal, Anatomy of the abdominal organs and their vasculature

Unit 4: Head and Neck

Bones, joints, muscles, and nerves of the head and neck, Anatomy of the skull and cranial fossae, Anatomy of the face, oral cavity, and pharynx, Anatomy of the neck regions and cervical plexus, Major blood vessels and nerves of the head and neck

Unit 5: Central Nervous System and Spinal Cord

Structure and function of the brain and its major divisions, Anatomy of the cranial nerves, Spinal cord structure and tracts, Cerebrospinal fluid and its circulation, Anatomy of the ventricular system and meninges

Learning Outcomes:

1. Demonstrate Foundational Knowledge: Understand the fundamental principles of anatomy, including anatomical terminology, subdivisions, and the hierarchical organization of the human body's structures.
2. Identify and Describe Structures: Recognize and describe the bones, joints, muscles, and nerves specific to the upper limb, thorax, lower limb, abdomen, head, neck, and central nervous system.
3. Analyze Functional Relationships: Analyze the functional relationships between anatomical structures, such as how joints facilitate movement, nerves innervate muscles, and blood vessels supply organs.
4. Apply Clinical Relevance: Apply anatomical knowledge to clinical scenarios, understanding how variations and abnormalities in anatomical structures can contribute to medical conditions, diagnoses, and treatment approaches.
5. Utilize Anatomical Language: Effectively communicate anatomical information using accurate terminology, diagrams, and models to convey spatial relationships and anatomical concepts.

References:

1. "Gray's Anatomy for Students" by Richard Drake, A. Wayne Vogl, and Adam W.M. Mitchell
2. “BD Chaurasia's Human Anatomy" by Dr. B.D. Chaurasia
3. "Inderbir Singh's Textbook of Human Histology: With Colour Atlas & Practical Guide" by Dr. Inderbir Singh
4. "Essential of Anatomy: Head and Neck" by Vishram Singh
5. "Clinically Oriented Anatomy" by K. L. Kumar

Course Type: DSCC-IIBIOCHEMISTRY

Total Hours: Total Hours: 120 hours Theory- 60 hours

Practical- 60 hours

Course Objectives:

1. Understand Cellular Organization and Division: Describe the structural and functional differences between prokaryotic and eukaryotic cells. Explain the processes of mitosis and meiosis, understand the phases of the cell cycle, and analyze the regulation of cell growth and division.
2. Explore Cellular Organelles: Analyze the internal organization of the nucleus, endoplasmic reticulum, Golgi apparatus, lysosomes, mitochondria, chloroplasts, peroxisomes, and glyoxysomes. Understand their morphology, functions, and roles in cellular processes.
3. Apply Methods in Cell Biology: Apply techniques for disrupting tissues and cells, including organ and tissue slice techniques, isolation of clones, and cell culture methods. Understand cell

fixation methods for both light and electron microscopy and appreciate their significance in cell biology research.

4. Examine Cellular Communication and Transport: Examine the differentiation of cell membranes, cell adhesion proteins, and various types of cell junctions. Understand the fluid mosaic model of the cell membrane, membrane protein types, and solute transport mechanisms, including passive and active transport.
5. Analyze Cell Death and Signaling: Differentiate between necrosis and apoptosis, understanding their underlying mechanisms including mitochondrial and death receptor pathways. Analyze cell signaling, including signaling molecules, receptors, intracellular signal transduction pathways, and the role of key molecules like G protein-coupled receptors, receptor tyrosine kinases, and MAP kinase pathways.

UNIT-I : CELLULAR ORGANIZATION, DIVISION AND CYTOSKELETONS

Cell types - organization of prokaryotic and eukaryotic cells, cell division - mitosis and meiosis, cell cycle - phases of cell cycle, and regulation of cell growth and cell cycle, cell motility - molecular motors, microtubules, structure and composition, microtubular associated proteins - role in intracellular motility.

UNIT-II : CELLULAR ORGANELLES

Cellular organelles - Nucleus - internal organization, traffic between the nucleus the nucleolus, and cytoplasm, endoplasmic reticulum - protein sorting and transport, golgi apparatus and lysosomes, morphology and function of mitochondria, chloroplasts and peroxisomes, glyoxysomes.

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UNIT-III : METHODS IN CELL BIOLOGY

Methods for disrupting tissues and cells, organ and tissue slice techniques, isolation of clones, tissue culture techniques (animal and plant), cell fixation - fluid fixatives, freezing and section drying, fixation for electron microscopy - buffered osmium solutions, fixation of organic and inorganic substances.

UNIT-IV : CELLULAR COMMUNICATION AND TRANSPORT

Differentiation of cell membrane - microvilli, tight junctions, epithelia, Bell and sqot desmosomes - mechanical function, cell-cell interaction, cell adhesion proteins, cell junctions, tight junctions, cell surface of plant cells and cancer cells. Overview of membrane protein - peripheral and integral, molecular model of cell membrane - fluid mosaic model and membrane fluidity, solute transport across membrane - passive transport, active transport by ATP powered pumps, types of transport systems.

UNIT-V : CELL DEATH AND SIGNALING

Cell aging and death - necrosis and apoptosis - mitochondrial and death receptor pathway. Cell signaling - signaling molecules and their receptors, functions of cell surface receptors, pathways of intracellular signal transduction, G protein coupled receptors, receptors tyrosine kinases, ras, MAP kinase pathways.

Learning Outcomes:

1. Analyze Cellular Structure and Division: Analyze and compare the organization of prokaryotic and eukaryotic cells. Describe the processes of mitosis and meiosis, and explain the phases of the cell cycle. Understand the molecular mechanisms that regulate cell growth and division.
2. Explain Organelle Functions: Explain the functions and roles of cellular organelles such as the nucleus, endoplasmic reticulum, Golgi apparatus, lysosomes, mitochondria, chloroplasts, peroxisomes, and glyoxysomes. Understand their contributions to cellular processes and overall cell function.
3. Apply Cell Biology Techniques: Apply various techniques for studying cells, including tissue disruption, organ and tissue slice methods, and cell culture techniques. Understand the principles

behind cell fixation for light and electron microscopy and apply appropriate methods for different research contexts.

4. Interpret Cellular Communication and Transport: Interpret the significance of cell membrane differentiation, cell adhesion proteins, and different types of cell junctions. Explain the fluid mosaic model of the cell membrane and interpret the mechanisms of solute transport, both passive and active, across cellular membranes.
5. Analyze Cell Signaling and Death: Analyze the processes of cell death, differentiating between necrosis and apoptosis. Understand the molecular pathways involved in cell signaling, including receptor types, intracellular signal transduction, and key molecules such as G protein-coupled receptors, receptor tyrosine kinases, and MAP kinase pathways.

Reference Books:

1. Lehninger Principles of Biochemistry" by David L. Nelson and Michael M. Cox (Indian adaptation by Michael M. Cox and G. G. Prabhakara Rao)
2. "Textbook of Biochemistry for Medical Students" by D.M. Vasudevan, S. Sreekumari, and KannanVaidyanathan
3. "Biochemistry" by U. Satyanarayana and U. Chakrapani
4. "Harper's Illustrated Biochemistry" by Robert K. Murray, David Bender, Kathleen M. Botham, Peter J. Kennelly, Victor W. Rodwell, and P. Anthony Weil (Indian adaptation by Dr. K. S. Vasudevan)

Course Type: DSEC-I Pharmaceutical Biochemistry and Toxicology

Total Hours: Total Hours: 120 hours Theory- 60 hours

Practical- 60 hours

Course Objectives:

UNITI

Biopharmaceutical properties of drugs: Mechanism of drug absorption – physiochemical factors versus drug absorption. Drug dissociation versus drug absorption. Isomerism and pharmacological activity. Structural features and pharmacological activity; geometric isomerism, configuration influence on pharmacologic activity. Effect of conformational isomerism on biological activity of drugs.

UNITII

Theoretical aspects of drug designing. Molecular modelling: Principles of computational chemistry, molecular mechanics, chemical methods. Hardware considerations, Software considerations. Receptors and drug action, Affinity – Role of chemical bonding. Dose – Response relationships, Receptor location, Receptor and the biological response. Receptor subtypes. Dynamic nature of receptors. Nonsteroidal anti – inflammatory drugs. Drugs affecting sugar metabolism. Drugs of clinical significance.

UNITIII

Drug metabolism: First phase metabolism – Elimination pathway – Entero - hepatic cyclingof

drugs. Drug biotransformation pathway – phase I – Hepatic cytochrome P_{450} enzyme system; Cytochrome P_{450} cycle – induction and inhibition. – Oxidation catalysed by cytochrome P_{450} isoforms – All types of hydroxylation, Deamination – Dealkylation – Dehalogenation. Oxidations: Microsomal & non – microsomal oxidations. Miscellaneous reductions.

UNITIV

Drug conjugation pathways- Phase – II: Hyaluronic acid conjugation – sulfate conjugation – conjugationwithaminoacids; Acetylation,Glutathioneconjugation,cyanideconjugation. Extra hepatic metabolism – Toxicity from oxidative metabolism. Drug interactions – Ame's test. Metabolic pathways of common drugs. Lovastatin, Acetaminophen, Ciprofloxacin, Caffeine, Theophylline, Nicotine, Ibuprofen, Tamoxifen. General toxicology: Basicprinciples of diagnosis. Mechanism of toxic effect, Toxico kinetics. Response of respiratory system, reproductive system, liver and kidney to toxic agents. Toxic effects of metals, solvents and environmental pollutants.

UNITV

Toxicology: Principles of toxicology and treatment of poisoning. Heavy metals and antagonists. Non-metallic environmental toxicants. Methods involved in the development of new drugs. Preclinical toxicological studies. Determination of LD_{50} and ED_{50}. Acute, sub-acute and chronic toxicity studies. Antidotes in the management of poisoning. Applied analytical toxicology and toxico vigilance.

Learning Outcome:

1. Students who complete this course will be able to
2. Understand clearly about the basic concepts of pharmacology
3. Have a thorough knowledge about the mechanism of drug action, Drug interaction, Receptors.
4. Know the aspects of new discovery of drugs and drug designing.
5. Recognize the principles of toxicology, Antidotes and the management of poisoning.

REFERENCEBOOKS

1. TextBookofBiochemistry,B.HarrowandA.Mazur,1996,9thEdition,W.B.SaundersCo., Philadelphia.

2. AnIntroductiontoPracticalBiochemistry,D.T.Plumer,1988.3rdEdition,TataMcGraw Hill, New Delhi.

3. PharmacologyandPharmacotherapeutics,Satoskar,R.Setal.,2015.24th

   Edition,Popular Prakasham, Bombay.

4. Applied Biopharmaceutics and Pharmacokinetics, Shargel,L. et al., 2015.7th Edition, McGraw- Hill Medical.

SEMESTER 2

Course Type: DSCC-III PHYSIOLOGY

Total Hours: Total Hours: 120 hours Theory- 60 hours

Practical- 60 hours

Course Objectives :

1. Understand Cellular Physiology: Comprehend the structure and function of cells, including the mechanisms of cell membrane transport, membrane potentials, action potentials, and synaptic transmission. Analyze the role of neurotransmitters in cellular communication and muscle cell physiology.
2. Explore Nervous System Functions: Explain the organization and functions of the central nervous system (CNS), autonomic nervous system (ANS), sensory and motor pathways. Investigate higher brain functions like cognition, memory, and language, along with the regulation of sleep and circadian rhythms.
3. Analyze Cardiovascular System Dynamics: Describe the anatomy of the heart, understand the cardiac cycle, and interpret ECG readings. Analyze the regulation of cardiac output and blood pressure, explore blood vessel structure, circulation, and comprehend blood composition and coagulation processes.
4. Examine Respiratory System Physiology: Study the anatomy and physiology of the respiratory system. Analyze pulmonary ventilation, gas exchange, transportation of respiratory gases in the blood, control of respiration, and adaptations and disorders related to respiration.
5. Investigate Renal Function and Fluid-Electrolyte Balance: Explore the kidney's structure, renal blood flow, filtration, reabsorption, and secretion processes. Understand acid-base balance regulation, fluid and electrolyte balance in the body, and how renal function is regulated.

Unit 1: Cell Physiology

Cell structure and function, Cell membrane transport mechanisms, Membrane potentials and action potentials, Synaptic transmission and neurotransmitters, Muscle cell physiology

Unit 2: Nervous System

Central nervous system (CNS) organization and functions, Autonomic nervous system (ANS) and its divisions, Sensory and motor pathways, Higher functions of the brain (cognition, memory, language, etc.), Sleep and circadian rhythms

Unit 3: Cardiovascular System

Anatomy and physiology of the heart, Cardiac cycle and ECG interpretation, Regulation of cardiac output and blood pressure, Blood vessels and circulation, Blood composition and coagulation

Unit 4: Respiratory System

Anatomy and physiology of the respiratory system, Pulmonary ventilation and gas exchange,Transport of respiratory gases in the blood,Control of respiration, Respiratory adaptations and disorders

Unit 5: **Renal and Fluid-Electrolyte Balance**

Kidney structure and renal blood flow, Renal filtration, reabsorption, and secretion, Acid-base balance and regulation, Fluid and electrolyte balance in the body, Renal function and its regulation

Learning Outcomes:

1. Demonstrate Cellular Understanding: Apply a comprehensive understanding of cell physiology to explain the mechanisms of cell membrane transport, action potentials, synaptic transmission, and muscle cell function.
2. Explain Nervous System Functions: Explain the functions of the central nervous system (CNS), autonomic nervous system (ANS), sensory and motor pathways, and higher brain functions. Describe the regulation of sleep and circadian rhythms.
3. Interpret Cardiovascular Dynamics: Interpret electrocardiogram (ECG) readings, describe the cardiac cycle, and explain the regulation of cardiac output and blood pressure. Analyze the role of blood vessels in circulation and understand blood composition and coagulation.
4. Apply Respiratory Knowledge: Apply knowledge of respiratory anatomy and physiology to understand pulmonary ventilation, gas exchange, transport of respiratory gases, control of respiration, and respiratory adaptations in various conditions.
5. Evaluate Renal and Fluid-Electrolyte Processes: Evaluate kidney structure and function, understand renal blood flow, and analyze the processes of filtration, reabsorption, and secretion. Explain the regulation of acid-base balance, fluid-electrolyte balance, and the physiological basis of renal function.

References:

1. "Guyton and Hall Textbook of Medical Physiology" by John E. Hall
2. "Human Physiology: An Integrated Approach" by Dee Unglaub Silverthorn
3. "Vander's Human Physiology" by Eric P. Widmaier, Hershel Raff, and Kevin T. Strang
4. "Ganong's Review of Medical Physiology" by Kim E. Barrett, Susan M. Barman, Scott Boitano, and Heddwen L. Brooks
5. "Textbook of Physiology for Dental Students" by Indu Khurana

Course Type: DSCC-IV BIOCHEMISTRY

Total Hours: Total Hours: 120 hours Theory- 60 hours

Practical- 60 hours

Course Objectives:

1. Master Carbohydrate Chemistry Fundamentals: Develop a comprehensive understanding of carbohydrates, encompassing their classifications, structures, and biological importance. Analyze glycosidic linkages, disaccharides, and polysaccharides, along with their chemical properties and functions.
2. Explore Lipid Chemistry Concepts: Explore the diverse world of lipids, encompassing their classification, structure, and biological significance. Understand fatty acids, glycerolipids, sphingolipids, and cholesterol, evaluating their roles in cell structure, signaling, nutrition, and medicine.
3. Comprehend Amino Acid Principles: Grasp the intricacies of amino acids, their structures, properties, and classifications. Analyze amino acid stereochemistry, acid-base properties, and their roles in peptide bond formation, protein structure, biochemistry, and nutrition.
4. Analyze Protein Structure and Function: Analyze the structural intricacies of proteins, from primary to quaternary levels. Understand protein folding, stability, ligand interactions, and the significance of chaperones. Explore proteomics, protein analysis techniques, and applications in biopharmaceuticals and biotechnology.
5. Understand Enzyme Function and Regulation: Understand the definition and classification of enzymes, their biological roles, and mechanisms. Master enzyme kinetics, inhibition, and regulation, including allosteric control. Analyze enzyme mechanisms, substrate specificity, and applications in biotechnology and medicine.

Unit-I: Carbohydrate Chemistry

Carbohydrates: Definition, classification, and biological significance, Monosaccharides: Structure, stereochemistry, and cyclic forms, Glycosidic linkages: Formation and hydrolysis of glycosidic bonds, Disaccharides and oligosaccharides: Structure and properties, Polysaccharides: Starch, cellulose, glycogen, chitin, and their functions, Chemical reactions of monosaccharides: Oxidation, reduction, and glycosylation, Carbohydrate conformations: Chair and boat conformations, anomeric effects, Carbohydrate derivatives: Esterification, etherification, and protecting groups, Carbohydrate analysis techniques: Chromatography, spectroscopy, and mass spectrometry, Carbohydrates in medicinal chemistry: Importance in drug design and glycan-based therapies, Future perspectives in carbohydrate chemistry.

Unit-II: Lipid Chemistry

Lipids: Definition, classification, and biological significance, Fatty acids: Structure, properties, and classification (saturated, unsaturated, trans fats), Glycerolipids: Triglycerides, phospholipids, and cell membrane structure, Sphingolipids: Structure and roles in cell signaling, Cholesterol and steroids: Structure and biological importance, Lipids in nutrition: Dietary lipids and health implications, Lipids in medicine: Lipid-based drug delivery and therapeutic applications, Lipids in industry: Applications in food, cosmetics, and biodiesel production, Lipid analysis techniques: Chromatographic and spectroscopic methods, Lipidomics: Overview and applications in systems biology, Future trends in lipid chemistry.

UNIT-III: Amino Acid Chemistry

Amino acids: Structure, classification, and properties, Amino acid stereochemistry: Chirality and optical activity, Acid-base properties and pKa values, Peptide bond formation and primary structure of proteins, Amino acid derivatives and analogues, Amino acids in biochemistry: Enzyme active sites and catalysis, Amino acids in nutrition: Essential amino acids and health implications, Amino acids in medicine: Therapeutic applications, Future perspectives in amino acid chemistry.

UNIT-IV: Protein Chemistry

Proteins: Structure, function, and significance in living organisms.Protein primary and secondary structure: Amino acid sequence, alpha-helix, beta-sheet, Protein tertiary and quaternary structure: Three-dimensional folding, subunit assembly, Protein conformation and stability: Factors influencing stability, denaturation, and renaturation, Protein-ligand interactions: Binding kinetics, specificity, and ligand-induced conformational changes,Protein folding and chaperones: Folding pathways, chaperone-mediated quality control, Proteomics and protein analysis: High-throughput techniques, mass spectrometry for protein identification, Protein assemblies and aggregates: Quaternary structures, misfolding, and aggregation diseases, Applications of protein chemistry: Protein-based therapies, biopharmaceuticals, and biotechnology, Future perspectives and emerging trends in protein chemistry.

Unit-V: Enzymology

Enzymes: Definition and classification, biological functions, Enzyme kinetics: Michaelis-Menten equation, Lineweaver-Burk plot, Enzyme inhibition and regulation: Competitive, non-competitive, uncompetitive inhibition, allosteric regulation, Enzyme mechanisms: Covalent, acid-base, metal ion catalysis, transition state stabilization, Enzyme substrate specificity: Substrate recognition and binding interactions, Enzymes in biotechnology: Industrial applications, enzyme engineering, Enzymes in medicine: Drug targeting, enzyme-based diagnostics, Future perspectives and emerging trends in enzymology.

Learning Outcomes:

1. Carbohydrate Chemistry: Understand the classification, structure, reactions, and analytical techniques of carbohydrates, along with their biological roles.
2. Lipid Chemistry: Comprehend the classification, structure, roles, and analysis of lipids, including their significance in various applications.
3. Amino Acid Chemistry: Gain insight into the properties, structure, functions, and potential applications of amino acids in different contexts.
4. Protein Chemistry: Grasp the hierarchy, stability, interactions, and diverse applications of proteins, considering their structural and functional aspects.
5. Enzymology: Acquire knowledge about enzyme classification, kinetics, inhibition, and practical applications, focusing on their critical role in biochemical processes.

Reference Books:

1. Lehninger Principles of Biochemistry" by David L. Nelson and Michael M. Cox (Indian adaptation by Michael M. Cox and G. G. Prabhakara Rao)
2. "Textbook of Biochemistry for Medical Students" by D.M. Vasudevan, S. Sreekumari, and KannanVaidyanathan
3. "Biochemistry" by U. Satyanarayana and U. Chakrapani

4. "Harper's Illustrated Biochemistry" by Robert K. Murray, David Bender, Kathleen M. Botham, Peter J. Kennelly, Victor W. Rodwell, and P. Anthony Weil (Indian adaptation by Dr. K. S. Vasudevan)

DSEC II-

Course Objectives:

1. Comprehensive Understanding of Endocrine Systems:
   - Define and explain the components of the endocrine system.
   - Analyze the interplay between the endocrine, nervous, and immune systems.
2. Advanced Hormone Signaling Knowledge:
   - Explore intricate signaling pathways involved in hormone action.
   - Evaluate the cross-talk between different signaling cascades and their physiological implications.
3. In-depth Study of Steroid Hormones and Receptors:
   - Examine the synthesis, metabolism, and regulation of steroid hormones.
   - Analyze the structural and functional aspects of nuclear receptors and their role in gene transcription.
4. Peptide and Protein Hormones:
   - Investigate the biosynthesis, secretion, and post-translational modification of peptide and protein hormones.
   - Evaluate the mechanisms of receptor activation and downstream signaling pathways.
5. Neuroendocrine Integration:
   - Explore the intricate role of the hypothalamus and pituitary in neuroendocrine regulation.
   - Analyze the influence of neurotransmitters and neuropeptides in modulating endocrine functions.

Unit-1 Introduction to Advanced Endocrinology, Hormone Signalling Pathways, Steroid Hormones and Receptors

Overview of the endocrine system and its components. Review of basic endocrine physiology. Introduction to advanced topics in endocrinology. Intracellular signallingmechanisms. Second messenger systems. Integration of signalling pathways in endocrine regulation. Synthesis and metabolism of steroid hormones. Nuclear receptors and transcriptional regulation. Clinical implications and disorders related to steroid hormones.

Unit-2 Peptide and Protein Hormones, Neuroendocrinology, Endocrine Glands and Tissues

Synthesis, secretion, and regulation of peptide hormones, Receptor activation and downstream signalling. Disorders related to peptide and protein hormones. Role of the hypothalamus and pituitary gland in endocrine regulation. Neurotransmitters and hormones in the central nervous system. Neuroendocrine disorders. Thyroid gland: Physiology and pathology. Adrenal glands: Cortisol and catecholamines. Pancreatic hormones and diabetes.

Unit-3Reproductive Endocrinology, Special Topics in Advanced Endocrinology

Male reproductive endocrinology. Female reproductive endocrinology

Endocrine aspects of pregnancy. Endocrine disruptors and environmental influences

Aging and the endocrine system. Emerging trends and technologies in endocrinology research

Learning Outcomes:

1. Knowledge and Understanding:

Demonstrate a profound understanding of advanced concepts in endocrinology, encompassing hormone signaling, regulation, and interconnections with other physiological systems.

2. Hormone Signaling and Pathways:

Evaluate and describe the intricate mechanisms of hormone signaling pathways, including second messenger systems and cross-talk between pathways.

3. Steroid Hormones and Receptors:

Explain the synthesis, metabolism, and physiological roles of steroid hormones.

Analyze the structure and function of nuclear receptors and their role in gene transcription.

4. Peptide and Protein Hormones:

Investigate the synthesis, secretion, and regulatory mechanisms of peptide and protein hormones.

Assess the complexities of receptor activation and downstream signaling cascades.

5. Neuroendocrine Integration:

Understand the critical role of the hypothalamus and pituitary in neuroendocrine regulation.

Analyze the impact of neurotransmitters and neuropeptides on endocrine functions.

Reference Books:

1. **"Williams Textbook of Endocrinology" by Shlomo Melmed, Kenneth S. Polonsky, P. Reed Larsen, and Henry M. Kronenberg**
2. **"Endocrinology: Adult and Pediatric" by J. Larry Jameson and Leslie J. De Groot**
3. **"Greenspan's Basic & Clinical Endocrinology" by David G. Gardner and Dolores Shoback**
4. **"Endocrine Physiology" by Patricia E. Molina**
5. **"Endocrine Secrets" by Michael T. McDermott**

SEMESTER 3

Course Type: DSCC-V HEMATOLOGY & CLINICAL PATHOLOGY

Total Hours: Total Hours: 120 hours Theory- 60 hours

Practical- 60 hours

Course Objectives:

1. Introduction to Haematology and Clinical Pathology: Provide students with an overview of the field's history and importance in healthcare. Introduce laboratory techniques, cellular adaptations, inflammation processes, and the molecular basis of diseases.

2. Explore Hematopoiesis and Blood Cell Morphology: Understand blood cell development and differentiation. Develop proficiency in identifying and interpreting normal and abnormal blood cell morphology. Study various hematological disorders, their etiology, pathophysiology, clinical presentation, and management.

3. Study Clinical Pathology and Laboratory Techniques: Introduce the principles of clinical chemistry, immunology, microbiology, and serology. Train students in the application of laboratory tests for disease diagnosis and monitoring. Provide hands-on experience in various laboratory techniques.

4. Examine Neuropathology: Study the biochemistry of neurological disorders, neurodegenerative diseases, and protein misfolding. Understand neurochemical analysis, gross and microscopical anatomy of the brain and spinal cord, histochemical and immuno-histochemical techniques, and the clinical context of diagnostic challenges.

5. Analyze Blood Transfusion and Transplantation: Learn about blood transfusion practices, compatibility testing, transfusion reactions, stem cell transplantation, and related therapeutic approaches. Develop skills in analyzing and presenting case studies related to hematological and clinical pathology conditions.

UNIT I - Introduction to Hematology and Clinical Pathology:

Overview of the field, history, and importance of hematology and clinical pathology in healthcare, Introduction to laboratory techniques and equipment used in diagnostic pathology, Cellular adaptations, injury, and cell death, Inflammation and repair processes, Molecular Basis of Disease, Molecular mechanisms underlying disease development, Genetic and epigenetic factors in pathology.

UNIT II - Hematopoiesis , Blood Cell Morphology and Hematological Disorders

Study of blood cell development and differentiation, Identification and interpretation of normal and abnormal blood cell morphology, In-depth study of various hematological disorders, including anemia, leukemias, lymphomas, and coagulation disorders. Understanding the etiology, pathophysiology, clinical presentation, and management of these disorders.

UNIT III - Clinical Pathology and Laboratory Techniques

Introduction to clinical chemistry, immunology, microbiology, and serology, Understanding the principles and application of these laboratory tests in disease diagnosis and monitoring, Hands-on training in various laboratory techniques, such as blood smear preparation and staining, hemoglobin electrophoresis, bone marrow aspiration, flow cytometry, etc.

UNIT IV-Neuropathology

Biochemistry of neurological disorders, Neurodegenerative diseases and protein misfolding, Neurochemical analysis in brain pathology, General pathology Gross and microscopical anatomy of the developed brain and spinal cord, Principles and use of histochemical techniques, Principles and use of immuno-histochemical techniques, Clinical context of the diagnostic dilemma, The law regulating the removal, retention and use of human tissue, Functional neuroanatomy, Clinico-anatomical correlation, Diseases of the nervous system

UNIT V - Blood Transfusion and Transplantation:

Study of blood transfusion practices, compatibility testing, and transfusion reactions, Introduction to stem cell transplantation and related therapeutic approaches, Analyzing and presenting case studies related to various hematological and clinical pathology conditions.

Learning Outcomes:

1. **Introduction to Haematology and Clinical Pathology**
    - Understand the historical context and significance of hematology and clinical pathology.
    - Identify various laboratory techniques and equipment used in diagnostic pathology.
    - Explain cellular adaptations, inflammation, and molecular mechanisms underlying disease.
2. **Hematopoiesis and Blood Cell Morphology**
    - Comprehend blood cell development and differentiation.
    - Demonstrate proficiency in identifying normal and abnormal blood cell morphology.
    - Analyzehematological disorders, including etiology, pathophysiology, clinical presentation, and management.
3. **Clinical Pathology and Laboratory Techniques**
    - Explain the principles of clinical chemistry, immunology, microbiology, and serology.
    - Apply laboratory tests for disease diagnosis and monitoring.
    - Gain hands-on experience in various laboratory techniques.
4. **Neuropathology**

- Describe the biochemistry of neurological disorders and neurodegenerative diseases.
- Apply neurochemical analysis techniques in brain pathology.
- Utilize histochemical and immuno-histochemical techniques for neuropathological analysis.
- Relate clinical context to diagnostic challenges in neurological disorders.

5. **Blood Transfusion and Transplantation**
    - Understand blood transfusion practices, including compatibility testing and transfusion reactions.
    - Explain stem cell transplantation and related therapeutic approaches.
    - Analyze and present case studies related to hematological and clinical pathology conditions.

Reference:

1. Williams manual of hematology 10th edition
2. De Gruchys clinical hematology
3. Bethesda handbook of clinical hematology
4. Text and practical hematology

Course Type: DSCC-V Biochemistry – III Intermediary Metabolism & biological oxidation

Total Hours: Total Hours: 120 hours Theory- 60 hours

Practical- 60 hours

Course Objectives:

1. **Comprehend Carbohydrate Metabolism:**
    - Understand the biochemical pathways of glycolysis, gluconeogenesis, and the Pentose Phosphate Pathway (PPP).
    - Analyze the interplay between glycolysis and gluconeogenesis and their regulation.
    - Investigate glycogen metabolism and associated disorders.
2. **Master Lipid Metabolism:**
    - Examine the processes of fatty acid synthesis, oxidation, and regulation.

- Explore ketogenesis, triacylglycerol metabolism, lipoprotein transport, and cholesterol metabolism.
- Analyze disorders related to lipid storage and their impact on health.

3. **Comprehensively Study Amino Acid & Protein Metabolism:**
    - Understand the process of protein synthesis, including translation, tRNA, and genetic code.
    - Investigate amino acid catabolism, transamination, and the urea cycle for nitrogen disposal.
    - Analyze enzyme deficiencies and inborn errors of amino acid metabolism, as well as prion diseases.
4. **Explore Electron Transport Chain & Oxidative Phosphorylation:**
    - Examine the components of the Electron Transport Chain (ETC) and their roles in electron transfer.
    - Understand oxidative phosphorylation, ATP synthesis, and the regulation of ATP production.
    - Investigate inhibitors, uncouplers, and diseases associated with ETC dysfunction.
5. **Understand Xenobiotic Metabolism:**
    - Explore Phase I and Phase II reactions in xenobiotic metabolism.
    - Understand the role of cytochrome P450 enzymes, oxidation, reduction, and hydrolysis reactions.

Investigate conjugation reactions and the involvement of transferases in xenobiotic biotransformation

Unit 1: Carbohydrate metabolism

Glycolysis,Gluconeogenesis: Enzymes and reactions in gluconeogenesis, Regulation of gluconeogenesis; Interplay between glycolysis and gluconeogenesis, Pentose Phosphate Pathway (PPP); Role in nucleotide biosynthesis and redox balance, Glycogen Metabolism, Glycogen storage diseases, Regulation of Blood Glucose, Disorders of Carbohydrate Metabolism: Diabetes mellitus,Glycogen storage diseases, Galactosemia and fructose intolerance

Unit 2: lipid metabolism

Fatty acid synthesis (lipogenesis), Fatty acid oxidation (beta-oxidation), Regulation of fatty acid metabolism, Ketogenesis and ketone bodies, Triacylglycerol Metabolism, Triacylglycerol synthesis and breakdown, Lipoprotein metabolism and transport, Cholesterol Metabolism,

Cholesterol biosynthesis and regulation, Cholesterol transport and metabolism, Atherosclerosis and lipid-lowering therapies, Lipid Storage Disorders, Gaucher disease, Niemann-Pick disease, Tay-Sachs disease, etc.Obesity and Lipid Metabolism, Lipids in energy balance, Obesity-related metabolic disorders

Unit 4: Amino acid & protein metabolism

Protein Synthesis, Overview of translation, tRNA and the genetic code, Regulation of protein synthesis, Amino Acid Metabolism, Amino acid catabolism and transamination, Urea cycle and nitrogen disposal, Enzyme Deficiencies and Inborn Errors of amino acid metabolism, Phenylketonuria, Maple syrup urine disease, etc., Prion diseases, Protein misfolding and neurodegenerative diseases

Unit 5: Electron transport chain &oxidative phosphorylation

Components of the ETC (Complexes I, II, and III), Electron carriers (ubiquinone and cytochrome c), Electron transfer and proton pumping, Complex IV (cytochrome c oxidase), chemiosmotic theory, Oxidative Phosphorylation ATP Synthesis, ATP synthase(Complex V), Mechanism of ATP synthesis, Regulation of ATP production, Inhibitors and uncouplers, Regulation of Electron Transport and Energy Metabolism, Diseases related to ETC dysfunction (e.g., mitochondrial diseases)

Unit 6: Xenobiotics

Xenobiotic Metabolism - Phase I Overview of Phase I reactions**,**Cytochrome P450 enzymes, Role of oxidation, reduction, and hydrolysis reactions**,** Overview of Phase II reactions**,**Conjugation reactions (glucuronidation, sulfation, etc.)**,**Role of transferases in xenobiotic biotransformation, Xenobiotic metabolism in the liver**.**

Reference Books:

1. Lehninger Principles of Biochemistry" by David L. Nelson and Michael M. Cox (Indian adaptation by Michael M. Cox and G. G. Prabhakara Rao)
2. "Textbook of Biochemistry for Medical Students" by D.M. Vasudevan, S. Sreekumari, and KannanVaidyanathan
3. "Biochemistry" by U. Satyanarayana and U. Chakrapani
4. "Harper's Illustrated Biochemistry" by Robert K. Murray, David Bender, Kathleen M. Botham, Peter J. Kennelly, Victor W. Rodwell, and P. Anthony Weil (Indian adaptation by Dr. K. S. Vasudevan)

DSES ELECTIVE III: MICROBIAL BIOCHEMISTRY

Total Hours: Total Hours: 120 hours Theory- 60 hours

Practical- 60 hours

Course Objectives:

UNIT 1: Introduction, history, classical and molecular genetics. Mendel's Laws of inheritance and its applications, monohybrid and dihybrid crosses, types of dominance, test cross and back cross. Gene interactions: Incomplete dominance, codominance, duplicate genes, complementary genes, supplementary genes, lethal genes, pleotropic genes and multiple alleles.

UNIT 2: Mutation**:**

Spontaneous and induced mutation, physical and chemical mutagens; mechanism of gene mutation and importance of mutation; detection of mutation and directed mutagenesis, mechanism of DNA repair. Structural chromosomes aberrations: Deletion, duplication, inversion and translocation. Numerical alterations of chromosomes: Ploidy and their genetic implications.

UNIT 3: Population genetics:

Populations, gene pool, gene frequency, factors affecting gene frequencies. molecular clock and evolution, genetic variations, sources of variations: Hardy-Weinberg principles and its applications. Genetic mapping and Linkage: Gene mapping by in-situ hybridization; gene mapping from two point and three-point test cross**;** linkage: complete and incomplete linkage, linkage analysis and genetic maps, crossing over, cytological basis of crossing over, mechanism of crossing over; homologous recombination in eukaryotes and bacteria.

UNIT 4: Genome maps:

Genetic maps (linkage maps, cytogenetic maps including FISH); genetic markers; linkage mapping of DNA markers (AFLP, and STSs); physical mapping of genomes. Human genetics: Chromosomal theory of inheritance, sex determination and sex differentiation in animals, sex linkage, extra chromosomal inheritance; disorders of autosomes, disorders of sex chromosomes, disorders of sexual differentiation.

Learning Outcomes

1. Understanding the biochemical mechanism and pathophysiological process of diabetes and dyslipidemia and the importance of diagnosis.
2. Importance of diagnostic enzymes in clinical conditions, understanding of biochemistry and pathophysiology of amino and nucleic acid associate disorders.
3. Understanding the consequences of hormonal unbalance with reference to biochemistry and pathophysiology. Biochemistry and diagnosis of hematology and cancer conditions and the importance of diagnosis.

Reference Books:

1. Principles of Genetics by Gardner E.J, Simmons, M.J. & Snustad, D.P. John Wiley & Sons Inc, N.Y
2. Genetics: Analysis and Principles by Robert J. Brooker, 2011. McGraw Hill.
3. Essentials of Genetics, 2nd Ed. By William S. Klug & Michael R. Cummings 1996.Prentice Hall Internationals
4. Essential Genetics, 2nd Ed. by Daniel L. Hartl & Elizabeth W. Jones, 1999. Jones &Bartlett Publishers

5. Molecular Techniques in Crop Improvement by S. Mohan Jain and DS Brar. Springer
6. Plant Breeding and Biotechnology by Denis Murphy. Cambridge
7. Modern Livestock and Poultry Production by James R. Gillespie and Frank B. Flanders. Delmar Cengage Learning.

SEMESTER 4

Course Type: DSCC-VIIMOLECULAR BIOLOGY & MEDICAL GENETICS

Total Hours: Total Hours: 120 hours Theory- 60 hours

Practical- 60 hours

Course Objectives:

1. **Introduction to Molecular Biology and Genetics**: Familiarize students with the fundamental concepts of molecular biology and genetics. Highlight the historical development and significance of these fields in medical sciences. Understand cell structure, chromosome organization, and inheritance patterns.

2. **Explore DNA Structure, Replication, and Repair**: Study the double helix structure of DNA and the mechanisms of DNA replication. Understand DNA repair mechanisms and their importance. Explore transcription, translation, genetic code, and gene expression regulation.

3. **Study Molecular Techniques and Tools**: Gain proficiency in Polymerase Chain Reaction (PCR) and DNA sequencing methods. Learn about gene cloning, recombinant DNA techniques, and their applications in medicine, biotechnology, and genetically modified organisms (GMOs).

4. **Examine Medical Genetics and Human Diseases**: Introduce medical genetics principles, genetic counseling, and testing. Analyze various chromosomal aberrations and genetic disorders, including single-gene disorders. Understand the molecular basis of genetic diseases and mutations.

5. **Analyze Molecular Biology of Cancer**: Understand the genetic basis of cancer, oncogenes, and tumor suppressor genes. Explore cell signaling, mutations' role in cancer development, and the application of molecular diagnostics and targeted therapies in cancer treatment.

Unit 1: Introduction to Molecular Biology and Genetics

Basic concepts of molecular biology and genetics, historical development and significance in medical sciences, cell structure and function, Chromosome structure and organization, Cell cycle and cell division, Mendel's laws of inheritance, Pedigree analysis and inheritance patterns, Genetic variation and population genetics.

Unit 2: DNA Structure, Replication, and Repair

DNA Structure and Replication, Double helix structure of DNA, DNA replication: enzymes and mechanisms, DNA repair mechanisms, Transcription and translation, Genetic code and codon usage, Regulation of gene expression.

Unit 3: Transcription

Introduction to Transcription, Overview of gene expressionCentral dogma of molecular biology, Prokaryotic Transcription;Initiation , Elongation and Termination in Prokaryotic Transcription, Eukaryotic Transcription: RNA polymerases in eukaryotes, Transcription initiation; Enhancers and transcription factors, Post transcriptional modifications: Capping, splicing, and polyadenylation, Transcriptional Regulation: Mechanisms of gene regulationActivators, repressors, and coactivators;Transcriptional regulatory networks

Unit 4: Translation

Introduction to Translation:Distinction between transcription and translation; The genetic code and codons; Ribosomes and tRNAand its role in translation, Initiation, Elongation&Termination in Translation in Prokaryotes and eukaryotes ;Post-Translational Modification,Regulation of Translation, Quality Control in Translation: Ribosome quality control pathwaysNonsense-mediated decay, Proteasomal degradation

Unit 5: Molecular Techniques and Tools

PCR and DNA Sequencing, Polymerase Chain Reaction (PCR), DNA sequencing methods: Sanger sequencing, Next-Generation Sequencing (NGS),Gene cloning and expression, DNA recombinant techniques, Applications in medicine and biotechnology, Genetically modified organisms (GMOs), Applications in healthcare, agriculture, and industry.

Unit 6: Medical Genetics and Human Diseases

Introduction to Medical Genetics, Principles of medical genetics, Genetic counselling and testing, Chromosomal Aberrations and Genetic Disorders, Types of chromosomal abnormalities, Down syndrome, Turner syndrome, and other chromosomal disorders, Molecular Basis of Genetic Disorders-Single-gene disorders: cystic fibrosis, sickle cell anaemia, Molecular mechanisms and genetic mutations.

Learning Outcomes:

1. **Introduction to Molecular Biology and Genetics**
    - Define fundamental concepts in molecular biology and genetics.
    - Explain the historical development and importance of these fields in medical sciences.
    - Describe cell structure, chromosome organization, and inheritance patterns.
2. **DNA Structure, Replication, and Repair**
    - Describe the double helix structure of DNA and its significance.
    - Explain the process of DNA replication and the enzymes involved.

- Understand DNA repair mechanisms and their implications.
- Analyze transcription, translation, genetic code, and gene expression regulation.

3. **Molecular Techniques and Tools**
    - Demonstrate the use of Polymerase Chain Reaction (PCR) and DNA sequencing methods.
    - Explain gene cloning and recombinant DNA techniques.
    - Discuss applications of these techniques in medicine, biotechnology, and GMOs.
4. **Medical Genetics and Human Diseases**
    - Apply principles of medical genetics and genetic counseling.
    - Interpret chromosomal aberrations and genetic disorders.
    - Understand the molecular basis of single-gene disorders and mutations.
5. **Molecular Biology of Cancer**
    - Explain the genetic basis of cancer and oncogenes.
    - Describe cell signalling, mutations, and their roles in cancer development.
    - Discuss the application of molecular diagnostics, targeted therapies, and immunotherapies in cancer treatment.

Reference Books:

1. Biochemistry" by Jeremy M. Berg, John L. Tymoczko, and LubertStryer - Another popular and comprehensive biochemistry textbook.
2. "Essential Cell Biology" by Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander D. Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter - A fundamental book on cell biology.
3. "Genes XI" by Benjamin Lewin - An excellent resource for understanding molecular genetics and its applications.
4. "Molecular Cloning: A Laboratory Manual" by Michael Green, Joseph Sambrook, and Thomas Maniatis - A classic manual for molecular cloning techniques.
5. "Principles of Gene Manipulation and Genomics" by Sandy B. Primrose and Richard M. Twyman - A comprehensive guide to the principles and techniques of gene manipulation and genomics.
6. "Introduction to Protein Structure" by Carl Branden and John Tooze - A concise and well-illustrated book that explains the principles of protein structure.

7. "The Cell: A Molecular Approach" by Geoffrey M. Cooper - A detailed exploration of cell biology from a molecular perspective.

Course Type: DSCC-VIII NUTRITION AND DIETETICS

Total Hours: Total Hours: 120 hours Theory- 60 hours

Practical- 60 hours

Course Objectives:

1. **Foundational Knowledge:** Develop a comprehensive understanding of nutrition principles, including nutrient classification, energy metabolism, and digestion, emphasizing their role in maintaining health and preventing diseases.

2. **Practical Diet Planning:** Gain proficiency in designing nutritionally balanced diets for diverse populations, considering dietary guidelines, recommended allowances, and menu planning principles.

3. **Nutrient Function and Impact:** Explore the functions of macronutrients and micronutrients, and their effects on health and disease, enabling informed dietary choices and nutritional interventions.

4. **Clinical Nutrition Expertise:** Acquire evidence-based skills in medical nutrition therapy, focusing on disease management and nutritional support, while addressing various life stages and health conditions.

5. **Community Nutrition and Future Trends:** Understand the dynamics of public health nutrition, community intervention strategies, and emerging trends in nutrition science, fostering a holistic approach to promoting well-being.

Unit 1: Fundamentals of Nutrition and Dietetics. Introduction to Nutrition and its significance in health.Nutritional requirements across the lifecycle and classification of nutrients.Macronutrients: Carbohydrates, proteins, fats, digestion, absorption, and metabolism.Micronutrients: Vitamins, minerals, water, dietary fiber, and their roles.Energy metabolism and thermogenesis.

Unit 2: Diet Planning, Assessment, and Management. Dietary Guidelines and Recommendations: National and international perspectives.Recommended daily allowances (RDAs) and dietary reference intakes (DRIs).Dietary assessment methods and anthropometric measurements.Menu planning principles for diverse populations and meal management.Meal preparation, food safety, and sanitation.

Unit 3: Nutrients in Health and Disease . Carbohydrates: Structure, digestion, metabolism, and implications.Proteins: Amino acid metabolism, synthesis, and malnutrition.Lipids: Fatty acids, metabolism, lipoproteins, and lipid-related disorders.Functions, interactions, deficiency, and toxicity of vitamins and minerals.

Unit 4: Clinical Nutrition and Therapeutic Diets. Medical nutrition therapy and evidence-based disease management.Nutritional support: Enteral and parenteral nutrition, complications, monitoring.Nutritional interventions in chronic diseases: Diabetes, cardiovascular, renal disorders.Nutrition across life stages: Pregnancy, lactation, infancy, childhood, aging.

Unit 5: Public Health Nutrition and Future Trends. Public health nutrition: Assessing needs, designing interventions, evaluating outcomes.Community nutrition programs: Maternal-child health, school nutrition, food assistance.Nutrition education and behavior change strategies.Principles, regulations, and prevention of foodborne illnesses.Advances in nutrition science: Nutrigenomics, functional foods, sustainability, emerging research trends.

Learning Outcomes:

1. **Apply Nutritional Knowledge:**
    - Explain the importance of nutrition in overall health and its contribution to preventing diseases.
    - Describe the classification of nutrients and their roles in energy metabolism and digestion.
2. **Design Balanced Diets:**
    - Develop nutritionally balanced diets based on dietary guidelines and recommended allowances for different populations.
    - Plan menus considering menu planning principles, meal preparation, food safety, and sanitation.
3. **Analyze Nutrient Implications:**
    - Analyze the impact of macronutrients and micronutrients on health and disease, including the implications of deficiencies and toxicities.
4. **Implement Clinical Nutrition Strategies:**
    - Apply evidence-based medical nutrition therapy techniques to manage chronic diseases and conditions, considering diverse life stages.
    - Demonstrate knowledge of enteral and parenteral nutrition, complications, and monitoring.
5. **Engage in Community Nutrition and Future Trends:**
    - Design and evaluate community nutrition programs, considering maternal and child health, school nutrition, food assistance, and behavior change strategies.
    - Discuss advances in nutrition science, including nutrigenomics, functional foods, sustainability, and emerging research trends.

Reference Books:

1. Nutrition: Concepts and Controversies" by Frances Sizer and Ellie Whitney.

2. "Nutrition Therapy and Pathophysiology" by Marcia NahikianNelms, Kathryn P. Sucher, and Karen Lacey.

3. "Nutrition and Diet Therapy" by Linda Kelly DeBruyne, Kathryn Pinna, and Eleanor Noss Whitney.

4. "Krause's Food & the Nutrition Care Process" by L. Kathleen Mahan and Janice L. Raymond.

5. "Advanced Nutrition and Human Metabolism" by Sareen S. Gropper, Jack L. Smith, and James L. Groff.

6. "Williams' Basic Nutrition & Diet Therapy" by Staci Nix McIntosh and Sara Long Roth.

DSEC IV-Hereditary Metabolism System

Total Hours: Total Hours: 120 hours Theory- 60 hours

Practical- 60 hours

Course Objectives:

1. **Define and Classify Inborn Errors of Metabolism:**
   - Describe the concept of inborn errors of metabolism.
   - Classify metabolic disorders based on biochemical pathways and affected molecules.
2. **Understand the Biochemical Foundations:**
   - Explain the basic principles of normal metabolic pathways.
   - Understand the role of enzymes in metabolic reactions and their regulation.
3. **Explore the Genetic Basis:**
   - Describe the genetic mechanisms underlying inborn errors of metabolism.
   - Recognize different inheritance patterns and their implications for metabolic disorders.
4. **Analyze Carbohydrate Metabolism Disorders:**
   - Identify and explain disorders related to glycogen storage, galactosemia, and fructose metabolism.
   - Analyze disorders in gluconeogenesis and glycogenolysis, linking biochemical defects to clinical symptoms.
5. **Examine Amino Acid Metabolism Disorders:**
   - Evaluate the genetic and biochemical aspects of phenylketonuria (PKU) and other disorders of phenylalanine metabolism.
   - Analyze disorders related to branched-chain amino acids and aromatic amino acid metabolism.

Unit-1 Introduction to Inborn Errors of Metabolism, Biochemical Foundations of Metabolism

Definition and classification of inborn errors of metabolism, Historical perspectives and milestones in metabolic disorder research. Overview of normal metabolic pathways.

Introduction to enzyme function and regulation. Biochemical principles underlying metabolic homeostasis.

Unit-2 Carbohydrate Metabolism Disorders, Amino Acid Metabolism Disorders

Glycogen storage disorders. Galactosemia and fructose metabolism disorders. Disorders of gluconeogenesis and glycogenolysis. Phenylketonuria (PKU) and other disorders of phenylalanine metabolism. Maple syrup urine disease and other branched-chain amino acid disorders. Disorders of aromatic amino acid metabolism

Unit-3 Organic Academia's, Fatty Acid Oxidation Disorders

Propionic acidemia, methylmalonic acidemia. Disorders of the citric acid cycle. Methylcitrate cycle disorders. Medium-chain acyl-CoA dehydrogenase deficiency (MCADD). Carnitine palmitoyltransferase deficiency (CPT I and II). Very-long-chain acyl-CoA dehydrogenase deficiency (VLCADD)

Unit-4 Mitochondrial Disorders, Emerging Therapies and Research in Metabolic Disorders

Overview of mitochondrial function and structure. Mitochondrial DNA mutations and their impact. Clinical manifestations and diagnosis of mitochondrial disorders.Overview of current research in inborn errors of metabolism. Gene therapy, enzyme replacement therapy, and other emerging treatments. Ethical considerations in the management of metabolic disorders.

Unit-5Genetics of Metabolic Disorders

Mendelian and non-Mendelian inheritance patterns. Genomic basis of inborn errors of metabolism. Molecular diagnostic techniques for metabolic disorders

Learning Outcomes:

1. Understanding the Basics:
    - Define and classify inborn errors of metabolism.
    - Describe the historical development and key milestones in the study of metabolic disorders.
2. Biochemical Foundations:
    - Explain normal metabolic pathways and their regulation.
    - Understand the principles of enzyme function and its role in metabolic homeostasis.
3. Genetic Basis:
    - Describe the genomic basis of inborn errors of metabolism.
    - Recognize different patterns of inheritance for metabolic disorders.
4. Carbohydrate Metabolism:
    - Identify and explain disorders related to glycogen storage, galactosemia, and fructose metabolism.
    - Analyse the biochemical basis and clinical manifestations of disorders in gluconeogenesis and glycogenolysis.
5. Amino Acid Metabolism:

- Evaluate the genetic and biochemical aspects of phenylketonuria (PKU) and other disorders of phenylalanine metabolism.
- Analyse disorders related to branched-chain amino acids and aromatic amino acid metabolism.

Reference Books:

1. **"Inborn Metabolic Diseases: Diagnosis and Treatment" by Jean-Marie Saudubray, Georges van den Berghe, John H. Walter Jr.**
2. **"Physicians' Guide to the Diagnosis, Treatment, and Follow-Up of Inherited Metabolic Diseases" by Carla E. M. Hollak, Duran, M., and Saudubray, J.M.**
3. **"Inborn Errors of Metabolism: From Neonatal Screening to Metabolic Pathways" by Saudubray, Jean-Marie, van den Berghe, Georges, and Walter, John H.**
4. **"Metabolic and Molecular Bases of Inherited Disease" by Charles R. Scriver, Arthur L. Beaudet, David Valle, et al.**
5. **"Inborn Errors of Metabolism: A Clinical Guide" by Nicola Longo and Piero Rinaldo**

Semester V

Course Type: DSCC-IX IMMUNOLOGY

Total Hours: Total Hours: 120 hours Theory- 60 hours

Practical- 60 hours

Course Objectives:

1. **Understanding Immune System:** Acquire a comprehensive understanding of the immune system, including innate and acquired immunity, humoral and cell-mediated immunity, and the role of various immune components in defending against infections.

2. **Antibody Structure and Function:** Gain in-depth knowledge about antibody structure, classes, subclasses, and their properties. Explore the chemical basis of antigen-antibody interactions, affinity, valence, and the diverse roles antibodies play in immune responses.

3. **Lymphocyte Responses:** Learn about the functions of T and B lymphocytes, their interaction, response to antigens, and the role of cytokines and factors involved in coordinating immune responses. Understand the processes of B cell activation, plasma cell differentiation, and T cell-mediated immunity.

4. **Immunization and Serology:** Explore vaccination strategies, passive and active immunization, and the various types of vaccines used against bacteria, toxins, and viruses. Gain practical knowledge of serological techniques such as precipitation, agglutination, RIA, ELISA, and their applications in diagnosing immune-related conditions.

5. **Transplantation and Immune Disorders:** Understand the concepts of transplantation, graft rejection, transplantation antigens, and HLA compatibility. Study mechanisms of graft rejection and immunosuppressive approaches. Learn about hypersensitivity reactions, autoimmune diseases, and their underlying mechanisms.

Unit I: IMMUNITY

Types of immunity – innate and acquired. Humoral and cell mediated immunity. Immunity to infection: immune response, antibacterial resistance antiviral resistance, interfection, bacterial antigens, self antigens, MHC, Foreign antigen: Essential features of antigenicity – Factors that govern immune response, cross reactivity , Haptens, Tumor antigens, Viral antigens, Bacterial antigens, mononuclear phagocytic system. Inflammation: Acute and Chronic inflammation.

Unit II: Antibodies

Properties of antibody structure of IgG, isotopes, allotypes, idiotype, classes, subclasses, Igs as antigens. Monoclonal antibodies (Hybridomas). Ag-Ab complex: chemical basis of Ag-Ab binding, affinity, valence, kinetics of Ag-Ab reactions. Theories of antibody formation; generation of antibody diversity; genetics. Complement system: components of complement activation and its biological consequences – classical, alternative and lectin pathways.

Unit III : Lymphocytes

T and B cells, Lymphocyte, mitogens, response of B cells to antigens. Interaction between T and B cells.Macrophage co-operation, interleukins and other factors.Triggering of B cells, plasma cells, memory cell. Response of T cells to antigens – antigens that provide T cell response lymphokines, interleukins, cytotoxicity.

Unit IV: Vaccines

Vaccination – passive and active immunization schedule, antibacterial, antitoxic and viral vaccines. Serology: precipitation, agglutination, immune-electrophoresis, fluorescent antibody techniques, RIA and ELISA. Allergy and hypersensitivity: type I, II, III and IV hypersensitivity unsual and adverse to drugs, drug discovery, drug intolerance.

Unit V: Transplantation

Transplantation – graft rejection, transplantation antigens, HLA mechanism of graft rejection, prevention of graft rejection, immune suppressive agents' immune surveillance. Acute intolerance (tachyphyrais) Autoimmunity: mechanism of breakdown: rheumatoid arthritis; myasthenia gravis, immunity and aging, disorders of immunoglobulin synthesis.

Learning Outcomes:

1. **Differentiate Immune Responses:** Differentiate between innate and acquired immunity, and comprehend the distinct roles of humoral and cell-mediated immune responses in combating infections.

2. **Analyze Antibody Interactions:**Analyze the structure and functions of antibodies, explain the principles of antigen-antibody interactions, and evaluate their significance in immune defense and diagnostics.

3. **Evaluate Lymphocyte Functions:** Evaluate the functions of T and B lymphocytes, describe their activation processes, and interpret the roles of cytokines and intercellular communication in coordinating immune reactions.

4. **Apply Immunological Techniques:** Apply serological techniques like precipitation, agglutination, RIA, and ELISA to analyze immune reactions and diagnose immune-related disorders.

5. **Assess Immune Disorders:** Assess the mechanisms of graft rejection, understand transplantation antigens, and discuss immunosuppressive strategies. Analyze hypersensitivity reactions, autoimmune diseases, and their implications in clinical practice.

Reference:

1. Immunology (2007) Kuby Latest edition.

2. ROITT's Essential Immunology(2002) Wiley publication 12th edition.

3. L Cooper. Marcel Dekkar (1984) stress, immunity of ageing.

4. Biomedical Methods Hand Book-John M. WalksetRalphRaplay. Humana Press, 2005.

5. Elements of Medical Genetics. II th edition-Muller, Young - Churchill Livingstone, 2002.

5. Nucleic Acid Testing for Human Diseases. Ed. Attila Lorincz.Taylor and Francis Publishers(CRC, NY), 2006.

6. George P. Patrinos, WilhelmAnsorge, (2009). Molecular Diagnostics.

7. Immunology - A introduction – Tizard

8. Essential immunology – ROITT

9. Stress, immunity of ageing – L Cooper. Marcel Dekkar

10. Immunology – Kannan.MJP Publishers Edition: 2013

Course Type X : DSCC –Biotechnology

Total Hours: Total Hours: 120 hours Theory- 60 hours

Practical- 60 hours

Course Objectives :

1. Comprehend Foundations: Understand the fundamental principles, historical development, and diverse applications of biotechnology in various fields, particularly in medicine.

2. Master Molecular Processes: Grasp the intricate details of DNA structure, replication, transcription, and translation, enabling informed analyses of genetic information and molecular interactions.

3. Navigate Genetic Engineering: Acquire expertise in recombinant DNA technology, gene expression, and genetic engineering techniques, essential for manipulating genetic material and modifying organisms.

4. Harness Biotechnological Tools: Gain proficiency in employing essential biotechnological tools and techniques, such as PCR, gel electrophoresis, DNA sequencing, and molecular markers, to drive innovative research and experimentation.

5. Engage Ethical, Legal, and Social Discourses: Engage in critical discussions about the ethical, legal, and societal implications of biotechnology, fostering a comprehensive understanding of its impact on society and responsible scientific practice.

Unit I: Introduction to Biotechnology and Molecular Biology; Overview of biotechnology: Definition, historical development, and applications in medicine. Basics of molecular biology: DNA structure, replication, transcription, and translation. Recombinant DNA technology: Cloning, gene expression, and genetic engineering techniques. Tools and techniques in biotechnology: Polymerase chain reaction (PCR), gel electrophoresis, DNA sequencing, and molecular markers.

Unit II: Biotechnological Approaches in Medical Diagnostics ;Molecular diagnostics: Principles and applications of PCR-based assays, DNA sequencing, and hybridization techniques.Immunological diagnostics: Enzyme-linked immunosorbent assay (ELISA), western blotting, and flow cytometry.Biosensors and point-of-care devices: Principles and applications in disease diagnosis.Personalized medicine: Role of genetic testing and biomarker identification in treatment decisions.

Unit III: Biotechnology in Drug Development and Therapeutics Recombinant protein production: Expression systems, protein purification, and therapeutic protein development.Pharmacogenomics: Genetic basis of drug responses and individualized treatment approaches. Biopharmaceuticals: Monoclonal antibodies, vaccines, and gene therapy. Drug delivery systems: Nanotechnology-based drug delivery, targeted therapies, and controlled release.

Unit IV: Biotechnology and Regenerative Medicine. Stem cell technology: Types of stem cells, differentiation, and applications in tissue engineering and regenerative medicine.Organ transplantation: Xenotransplantation, tissue engineering, and immunomodulation.Gene editing and genome engineering: CRISPR-Cas9 technology and its potential in treating genetic disorders.3D bioprinting: Techniques and applications in creating functional tissues and organs.

Unit V: Ethical, Legal, and Social Issues in Biotechnology . Ethical considerations in biotechnology: Genetic manipulation, cloning, and research involving human subjects.Intellectual property rights and patenting in biotechnology.Regulatory frameworks: FDA and other agencies' guidelines for biotechnological products.Public perception and societal impacts of biotechnology: Communication, education, and ethical engagement.

Learning Outcomes

1. Analyze Applications: Evaluate and explain the diverse applications of biotechnology in medicine, recognizing its historical significance and contemporary relevance.

2. Deconstruct Molecular Processes: Break down the molecular processes of DNA structure, replication, transcription, and translation, demonstrating an ability to decipher genetic information and molecular mechanisms.

3. Apply Genetic Engineering Concepts: Apply the principles of recombinant DNA technology, gene expression, and genetic engineering to design and execute experiments aimed at modifying genetic material and engineering organisms.

4. Execute Biotechnological Techniques: Demonstrate proficiency in performing essential biotechnological techniques, including PCR, gel electrophoresis, DNA sequencing, and molecular marker analysis, enabling accurate experimentation and data interpretation.

5. Engage Ethical, Legal, and Social Discourses: Engage in thoughtful discussions about the ethical implications, legal frameworks, and societal impacts of biotechnology, showcasing an understanding of responsible scientific conduct and effective communication.

DSEC V:Neurochemistry

Total Hours: Total Hours: 120 hours Theory- 60 hours

Practical- 60 hours

Course Objectives:

1. **Understand the Basics of Neurotransmission:**
   Describe the fundamental concepts of neurotransmission.
   Identify key neurotransmitters and their roles in neuronal communication.
2. **Explore Neurochemical Signaling Pathways:**
   Examine the intracellular signaling pathways involved in neurotransmission.
   Understand the mechanisms of synaptic transmission and modulation.
3. **Study Neuronal Membrane Potentials and Excitability:**
   Explore the generation and propagation of action potentials.
   Understand the role of ion channels and membrane potentials in neuronal excitability.
4. **Investigate Neurotransmitter Receptors:**
   Classify and describe different types of neurotransmitter receptors.

Explore the structure and function of ionotropic and metabotropic receptors.

5. **Examine Neurotransmitter Release and Uptake:**
   Investigate the process of neurotransmitter release and its regulation.
   Understand the mechanisms of neurotransmitter uptake and reuptake.

Neurochemistry

Unit I - Introduction to Neurobiology, Neurotransmitters, Neurochemical Pathways:

Overview of the nervous system, Neuron structure and function, Neurotransmission and signaling, Structure and function of neurotransmitters (e.g., acetylcholine, dopamine, serotonin), Synthesis, release, and reuptake mechanisms.Study of major neurochemical pathways (e.g., cholinergic, dopaminergic).Metabolism and regulation of neurotransmitters.

Unit II Neurotransmitter Receptors, Neurochemistry of Neurological Disorders:

Types of neurotransmitter receptors (ionotropic and metabotropic), Signal transduction mechanisms.Biochemical basis of neurodegenerative diseases (e.g., Alzheimer's, Parkinson's).Neurochemical aspects of psychiatric disorders (e.g., depression, schizophrenia).

Unit III Neuroendocrinology, Neurochemistry of Learning and Memory,Neurochemistry of Drugs and Addiction, Neuroprotection and Repair:

Hormones and neurotransmitters in the regulation of the endocrine system.Molecular mechanisms underlying learning and memory.Long-term potentiation (LTP) and synaptic plasticity.Effects of drugs on neurotransmitter systems.Biochemical basis of addiction.Cellular mechanisms involved in neuroprotection**.**Neurochemical aspects of neural regeneration.

Unit IV Neuroimaging Techniques, Molecular Genetics in Neurobiology, Ethical Considerations in Neurobiochemistry:

Introduction to various neuroimaging methods (MRI, PET, fMRI).Application of neuroimaging in research and clinical settings.Genetic basis of neurological disorders.Molecular techniques in neurogenetics.Ethical issues related to neuroscience research and treatment.Responsible conduct in neurobiochemical research.

Unit VResearch Methods in Neurobiochemistry, Seminar and Literature Review:

Laboratory techniques for studying neurobiochemical processes.Data analysis and interpretation.Critical analysis of current research articles in neurobiochemistry.Presentation of research findings.

Learning Outcomes:

1. Knowledge of Neurochemical Principles
2. Understanding Neurotransmission
3. Knowledge of Neurochemical Pathways
4. Comprehension of Neurological Disorders
5. Knowledge of Neuroendocrinology

Reference Books

1. Principles of Neural Science, Eric R. Kandel;
2. Neuroscience, Dale Purves;
3. The Human Nervous System, Mai Paxinos
4. Handbook of Neuroendocrinology, George Fink;
5. William's Textbook of Endocrinology, Krorenberg, Meaund;

Semester – VI

Course Type: **DSCC- XI Cancer Biology**

Total Hours: Total Hours: 120 hours Theory- 60 hours

Practical- 60 hours

Course Objectives:

1. Introduction to Cancer and Molecular Basis: Develop a comprehensive understanding of cancer, its causes, prevalence, and impact, while exploring the molecular mechanisms underlying cancer development through oncogenes, tumor suppressor genes, and DNA repair mechanisms.

2. Explore Cell Biology, Genetics, and Tumor Development: Analyze cellular structure, function, and the cell cycle, along with the roles of oncogenes and tumor suppressor genes in cancer. Investigate the genetic basis of cancer and the intricate processes involved in tumor development and progression.

3. Examine Cancer Causes, Risk Factors, and Immunology: Study the role of carcinogens, mutagens, environmental factors, and genetics in cancer causation. Understand altered metabolism in cancer cells, its therapeutic implications, and the significance of cancer immunology.

4. Understand Cancer Diagnosis, Staging, and Treatment: Gain proficiency in cancer diagnosis through biopsy, histopathology, and imaging techniques. Learn about cancer staging using the TNM system and explore diverse treatment modalities, including surgery, radiation therapy, chemotherapy, targeted therapies, and immunotherapies.

5. Analyze Cancer Prevention, Control, and Emerging Trends: Evaluate cancer prevention strategies and public health initiatives. Understand the identification and validation of cancer biomarkers for diagnosis, prognosis, and treatment response, while considering ethical considerations in biomarker research.

UNIT-I: Introduction to Cancer

Overview of cancer: Definition, causes, prevalence, and impact, hallmarks of cancer and cancer development, Molecular basis of cancer: oncogenes, tumor suppressor genes, and DNA repair mechanisms.

UNIT-II: Cell Biology and Genetics and Tumor Biology

Cellular structure and function, Cell cycle and regulation, Oncogenes and tumor suppressor genes, Genetic basis of cancer, Tumor development and progression, Tumor microenvironment, Angiogenesis and metastasis

UNIT-III: Cancer Causes and Risk Factors and Cancer Immunology

Carcinogens and mutagens, Environmental factors and lifestyle choices, Genetic predisposition to cancer, Carcinogens and mutagens, Environmental factors and lifestyle choices, Genetic predisposition to cancer, Altered metabolism in cancer cells, Warburg effect and metabolic reprogramming, Targeting cancer metabolism for therapy, tumor Microenvironment, Cellular and non-cellular components of the tumor microenvironment, stromal interactions and their influence on cancer progression, Therapeutic implications of the tumor microenvironment

UNIT-IV: Cancer Diagnosis, Staging and Cancer Treatment

Biopsy and histopathology, Imaging techniques for cancer detection, TNM staging system, Surgery, radiation therapy, and chemotherapy, Targeted therapies, Immunotherapies

UNIT-V: Cancer Prevention and Control, Emerging Trends in Cancer Research

Cancer prevention strategies, Public health initiatives, Cancer prevention strategies, Public health initiatives, Identification and validation of new cancer biomarkers, Biomarkers for diagnosis, prognosis, and treatment response, Ethical considerations in biomarker research.

Learning Outcomes:

1. **Introduction to Cancer**
    - Define cancer and assess its impact on health and society.
    - Describe the hallmarks of cancer and their role in cancer development.
    - Explain the molecular basis of cancer involving oncogenes, tumor suppressor genes, and DNA repair mechanisms.
2. **Cell Biology, Genetics, and Tumor Biology**
    - Discuss cellular structure, function, and cell cycle regulation.
    - Analyze the roles of oncogenes and tumor suppressor genes in normal and cancer cells.
    - Explain the genetic basis of cancer and its implications for tumor development, progression, and microenvironment.
3. **Cancer Causes, Risk Factors, and Immunology**
    - Identify carcinogens, mutagens, and environmental factors contributing to cancer.
    - Discuss genetic predisposition to cancer and altered metabolism in cancer cells.

- Describe the immune response in cancer and its potential for therapeutic interventions.

4. **Cancer Diagnosis, Staging, and Treatment**
    - Apply biopsy and histopathology for cancer diagnosis.
    - Utilize imaging techniques in cancer detection.
    - Understand the TNM staging system and various cancer treatment modalities.
5. **Cancer Prevention, Control, and Emerging Trends**
    - Evaluate cancer prevention strategies and their implementation.
    - Explain the importance of cancer biomarkers for diagnosis, prognosis, and treatment response.
    - Consider ethical considerations in cancer biomarker research and emerging trends in cancer research.

Reference books

1. Harpers review of Biochemistry Murray. K. Appleton & Lange
2. Lehnigerrs principles of Biochemistry David L. Nelson CBS
3. Biochemistry LubertyStryerWH Freeman
4. Text book of Biochemistry with clinical correlations Devlin TM Wiley Liss 5 Biochemistry Voet D & Voet J John Wiley & Sons
5. Medical Biochemistry N V Bhagwan Jones & Bartlett Biochemistry Acase oriented Approach Montgomery C V Mosby
6. Duncan's Disease of Metabolism Bondy Academic press
7. Molecular cell Biology Harvey Lodish W.H. Freeman & Company
8. Clinical Biochemistry Latner W B Saunders

Course Type: DSCC- XII Specialized Tissue Biochemistry

Total Hours: Total Hours: 120 hours Theory- 60 hours

Practical- 60 hours

Course Objectives:

1. Explore Tissue Biochemistry Fundamentals: Develop a foundational understanding of biochemistry and its relevance to specialized tissues, emphasizing the structure-function relationship in the eye, extracellular matrix (ECM), and bones.

2. Examine Metabolism in the Eye: Investigate the biochemical processes underlying vision and phototransduction, focusing on photoreceptor cells, retinal pigments, and the visual cycle.

3. Analyze Extracellular Matrix (ECM) Biochemistry: Delve into the composition and organization of the ECM, its role in tissue development, repair, and remodeling, and its connection to connective tissue-related diseases.

4. Understand Bone Biochemistry and Metabolism: Explore the composition and structure of bone tissue, bone cell types, mineralization, and energy metabolism, along with their interplay in bone remodeling and calcium homeostasis.

5. Study Cellular Signaling in Specialized Tissues and Diseases: Learn about signal transduction pathways, growth factors, and their role in tissue development, and investigate the biochemical basis of eye, ECM, and bone-related diseases.

UNIT-I: Introduction to Tissue Biochemistry

Overview of biochemistry and its relevance to specialized tissues, Structure and function of specialized tissues: eye, extracellular matrix (ECM), and bones, Overview of tissue-specific biochemistry,Cell signaling pathways in specialized tissues,Gene expression and regulation in different tissues

UNIT-II: Eye Metabolism

Structure and function of the eye, Biochemical processes in vision, Photoreceptor cells and phototransduction, Retinal pigments and visual cycle Photoreceptor Cells, Retinal Pigment Epithelium (RPE) Metabolism, Aqueous Humor Metabolism

UNIT-III: Extracellular Matrix (ECM) Biochemistry

Composition and organization of the ECM, Collagens, proteoglycans, and other ECM components, Role of ECM in tissue development and homeostasis, ECM remodeling and tissue repair, Extracellular matrix composition and function, Collagen synthesis and degradation, Connective tissue-related diseases and therapies

UNIT-IV: Bone Biochemistry and Metabolism of Specialized Tissues

Composition and structure of bone tissue, Bone cell types: osteoblasts, osteocytes, and osteoclasts, Bone mineralization and matrix proteins, Bone remodeling and calcium homeostasis, Energy metabolism in the eye, ECM, and bones, Tissue-specific metabolic adaptations, Regulation of metabolic pathways in specialized tissues

UNIT-V:Cellular Signaling in Specialized Tissues and Diseases and Disorders, Advanced Techniques in Tissue Biochemistry

Signal transduction pathways in the eye, ECM, and bones, Growth factors and their role in tissue development and repair, Signaling cascades and tissue-specific responses, Biochemical basis of eye diseases (e.g., cataracts, glaucoma, retinal degeneration), ECM-related disorders (e.g., connective tissue disorders), Bone-related diseases (e.g., osteoporosis, osteogenesis imperfecta), Molecular and biochemical methods for studying eye, ECM, and bone tissues,

Imaging techniques for tissue analysis, Omics approaches (genomics, proteomics) in specialized tissue research

Learning Outcomes:

1. **Introduction to Tissue Biochemistry**
    - Describe the importance of biochemistry in specialized tissues and their distinct functions.
    - Relate tissue structure to function, with a focus on the eye, ECM, and bones.
    - Recognize the significance of cell signaling and gene regulation in specialized tissues.
2. **Eye Metabolism**
    - Analyze the biochemical processes governing vision and phototransduction.
    - Explain the role of retinal pigments and photoreceptor cells in visual perception.
    - Discuss metabolism in the retinal pigment epithelium and aqueous humor.
3. **Extracellular Matrix (ECM) Biochemistry**
    - Identify ECM components and their contributions to tissue development and repair.
    - Discuss ECM remodeling processes and their implications for tissue homeostasis.
    - Explain the biochemical basis of connective tissue-related diseases and potential therapies.
4. **Bone Biochemistry and Metabolism of Specialized Tissues**
    - Describe bone tissue composition, including matrix proteins and bone cells.
    - Explain the process of bone mineralization and its regulation.
    - Analyze the connection between energy metabolism and tissue-specific adaptations.
5. **Cellular Signaling in Specialized Tissues and Diseases and Disorders, Advanced Techniques in Tissue Biochemistry**
    - Understand signal transduction pathways and their roles in tissue responses.
    - Explore growth factors' influence on tissue development and repair.
    - Describe the molecular and biochemical basis of eye, ECM, and bone-related diseases.

- Apply advanced techniques, such as molecular methods, imaging, and omics approaches, for studying specialized tissues.

Reference books

1. Molecular Biology of THE CELL. Bruce Albert Garland science, New York
2. Text book of Biochemistry West & Todd Oxford & IBH
3. Metabolic basis of inherited disease.. Stab Bury Churchill Livingstone
4. Biochemistry APPS W B Saunders
5. Principles of Biochemistry Abrham White Mac Graw Hill Inc.
6. Clinical Biochemistry Henry Churchill Livingstone
7. Krauses Food, Nutrition & Diet Therapy L.Kathleen Mahan W B Saunders
8. Clinical Physiology of acid - base and electrolyte disorders Rose BD Mac Graw Hill
9. Clinical Chemistry, Principles, Procedures& Correlations M.L.Bishop Lippincott

DSEC VI- Advanced Immunology

Course Objective:

1. **Mastering Immunological Foundations:**
   - Understand the advanced principles of innate and adaptive immunity.
   - Demonstrate an in-depth knowledge of immune cell types, their functions, and their interactions.
2. **Deciphering Signaling Pathways:**
   - Analyze and interpret intricate signaling pathways within the immune system.
   - Investigate the roles of cytokines, chemokines, and growth factors in immune cell communication.
3. **Advanced Cellular Immunology:**
   - Explore the molecular mechanisms of T and B cell activation and differentiation.
   - Examine the complexities of immune cell interactions in the context of various immune responses**.**
4. **Antigen Presentation and Processing Mastery:**
   - Understand and critically assess the intricacies of antigen presentation by different cell types.
   - Evaluate the impact of antigen presentation on immune recognition and response.
5. **Immunogenetics Proficiency:**
   - Apply knowledge of immunogenetics to understand the genetic basis of immune-related diseases.
   - Evaluate the significance of genetic variations in immune responses.

Unit-I Introduction to Advanced Immunology, Immunological Signaling Pathways, Cellular Components of the Immune System

Overview of the immune system: Cells, tissues, and organs. Historical perspective on immunology. Innate vs. adaptive immunity: Key differences and interactions. Cell signaling in the immune system. Cytokines and chemokines: Functions and regulation. Toll-like receptors (TLRs) and pattern recognition receptors (PRRs). T lymphocytes: Differentiation and function. B lymphocytes: Antigen recognition and antibody production. Natural killer (NK) cells: Role in innate immunity

Unit -2Antigen Presentation and Processing, Immunogenetics, Immune Tolerance and Autoimmunity

Major Histocompatibility Complex (MHC) molecules**.** Antigen-presenting cells (APCs)**.** Cross-presentation and its significance**.** Genetic basis of immune responses**.** Polymorphisms and disease susceptibility**.** HLA typing and transplantation**,** Central and peripheral tolerance mechanisms**,** Mechanisms of autoimmunity**,** Immunotherapy in autoimmune diseases**,** Hypersensitivity and Allergic Reactions**,** Types of hypersensitivity reactions**,** Mechanisms underlying allergies**,** Therapeutic approaches for allergic diseases

Unit-3 Immune Regulation, Vaccines and Immunization, Immunological Techniques and Technologies

Regulatory T cells (Tregs) and their role, Immune checkpoints and cancer immunotherapy, Homeostasis and feedback mechanisms in immune responses, Types of vaccines: Live attenuated, inactivated, subunit, etc.Vaccine development and design. Vaccine safety and public health implications, Flow cytometry and cell sorting. ELISA, Western blotting, and immunohistochemistry, Advances in imaging and single-cell technologies

Unit -4 Host-Pathogen Interactions

Viral and bacterial evasion of the immune system**.** Immunopathology of infectious diseases**.** Emerging infectious diseases and global health

Unit-5 Frontiers in Immunology Research

Immunometabolism. Microbiome and immune system interactions. Artificial intelligence in immunology. Student Presentations and Discussions. Research papers, case studies, or current literature reviews. Group discussions on recent immunology breakthroughs

Learning Outcome:

1. **Mastery of Immunological Concepts:**
   - Demonstrate a comprehensive understanding of advanced principles in both innate and adaptive immunity.
   - Apply knowledge to critically analyze and interpret complex immunological phenomena.

2. **Expertise in Immunological Signaling:**
   - Analyze intricate signaling pathways within the immune system, including cytokine, chemokine, and growth factor signaling.
   - Demonstrate the ability to connect signaling events to specific immune responses.
3. **Advanced Cellular Immunology Competence:**
   - Evaluate and explain molecular mechanisms underlying T and B cell activation, differentiation, and interactions.
   - Apply knowledge to understand immune responses in diverse physiological and pathological contexts.
4. **Proficiency in Antigen Presentation and Processing:**
   - Critically assess the process of antigen presentation by different cell types and its impact on immune recognition.
   - Apply understanding to analyze situations where antigen presentation may be altered.
5. **Application of Immunogenetics Knowledge:**
   - Utilize immunogenetics concepts to analyze the genetic basis of immune-related diseases.
   - Evaluate the significance of genetic variations in shaping immune responses and disease susceptibility.

Reference Books:

1. "Kuby Immunology" by Judy Owen, Jenni Punt, Sharon Stranford:
2. "Janeway's Immunobiology" by Kenneth Murphy, Casey Weaver:
3. "Cellular and Molecular Immunology" by Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai:
4. "Roitt's Essential Immunology" by Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt:
5. "Immunology" by Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne, Janis Kuby:

PRACTICAL SYLLABUS

SEMESTER I

DSSC-1 ANATOMY

1. Bones and Joints of the Upper Limb.

a) Identification of major bones of upper limb.

b) Examination of thoracic organs (lungs, heart) and associated structures.

2. Overview of lower limb and abdominal anatomy and their clinical significance.
a) Introduction to anatomical planes, sections, and terminology.
b) Bones and Joints of the Lower Limb Identification of major bones (femur, tibia, fibula) and joints (hip, knee, ankle).

3. Abdomen
   a) Identification of abdominal muscles (rectus abdominis)
   b) Examination of peritoneal structures and organ relationships.

4. Bones and Joints of the Skull and Neck
   a) Identification of major bones (skull, cervical vertebrae, hyoid bone, etc.) and joints (temporo- mandibular joint, atlanto-occipital joint).
   b) Examination of joint movements and ligament attachments.
   c) Identification of major muscles (facial muscles, muscles of mastication) of the head and neck.

5. Examination of the tongue, palate, tonsils, and related structures.

DSCC-II BIOCHEMISTRY

1. Introduction to Biochemical Techniques

a. Safety protocols and laboratory etiquette.

b. Basics of spectrophotometry and measurements of absorbance and concentration.

c.Use of micropipettes and preparation of reagent solutions.

2. Introduction to Cellular Organelles and Microscopy

3. Isolation and Fractionation of Organelles

4. Cell lysis and homogenization techniques for organelle isolation.

5. Differential centrifugation and density gradient centrifugation.

DSEP-IIIPHARMACEUTICAL BIOCHEMISTRY AND TOXICOLOGY

1. **Basic Laboratory Techniques,Biochemical Analysis, Cell Culture Techniques**:

   Handling laboratory equipment and glassware, Pipetting and dilution techniques, Measurement of pH, temperature, and other basic parameters, Protein isolation and purification techniques, Enzyme assays and kinetics studies, Spectrophotometry and colorimetric assays, Gel electrophoresis for nucleic acids and proteins, Cell staining and microscopy.

2. **Toxicology Studies, Drug Interaction Studies, Molecular Biology Techniques:** Evaluation of cytotoxicity, Assessment of genotoxicity, Metabolism and detoxification studies, Investigation of

drug-drug interactions, Metabolism and pharmacokinetic studies, DNA isolation and purification, Polymerase Chain Reaction (PCR), Gene expression analysis (RT-qPCR), Mass spectrometry for drug identification.

3. **Advanced Analytical Techniques, Data Analysis and Interpretation:** , High-performance liquid chromatography (HPLC) for drug quantification, Statistical analysis of experimental data, Data presentation and interpretation, Safety and Ethics in the Laboratory, Proper handling and disposal of hazardous materials, Adherence to ethical guidelines in research, Project Work, Design.

SEMESTER II

DSCC-III PHYSIOLOGY

1.Observation of osmosis, diffusion, and active transport in cells,Measurement of membrane potential and ion movements, cellular respiration and Energy Production,Observation of cell cycle stages (mitosis, meiosis) and cell division.

2.Cardiac Electrophysiology and ECG, Hands-on practice in recording and interpreting electrocardiograms (ECGs),Measurement of cardiac output and stroke volume using non-invasive techniques, Observation of blood components, including red blood cells, white blood cells, and platelets, Measurement of heart rate, blood pressure, and oxygen consumption during physical activity.

3.Measurement of lung volumes and capacities using spirometry,Interpretation of spirometry data and its significance,

4.Introduction to the instruments and equipment used for renal and fluid-electrolyte measurements, Measurement of GFR using inulin or creatinine clearance tests, Calculation of renal blood flow and its relationship to GFR

DSCC-IV BIOCHEMISTRY

1. Identification Of Carbohydrates

a) Identify the type of carbohydrate (monosaccharide, disaccharide, polysaccharide) based on characteristic tests (e.g., Benedict's test, Molisch's test, iodine test).
b) Analyze the results of color change or precipitation reactions to determine the presence of specific carbohydrate groups.
c) Given a structural formula of a monosaccharide, draw its Haworth projection and Fischer projection.
d) Perform a series of reactions on a carbohydrate sample, including: Oxidation of a monosaccharide with Tollens' reagent.
e) Reduction of a ketose to an aldose using sodium borohydride.

2. Chromatography

a) Thin-layer chromatography (TLC) for lipid separation and identification,Gas chromatography (GC) analysis of fatty acid composition.
b) Measuring lipid peroxidation using thiobarbituric acid reactive substances (TBARS) assay.
c) Quantitative analysis of amino acid content using high-performance liquid chromatography (HPLC).

d) SDS-PAGE (Sodium Dodecyl Sulfate-Polyacrylamide Gel Electrophoresis) for protein separation and molecular weight determination.

1. Western blotting for protein identification and characterization.

a) Protein-protein interaction analysis using techniques like co-immunoprecipitation.
b) Measurement of enzyme activity using colorimetric or spectrophotometric assays,
c) Determination of kinetic parameters (Vmax, Km) using Michaelis-Menten equation.
d) Effect of pH and temperature on enzyme activity.Enzyme-based assays for medical and biotechnological applications.

PRACTICAL FOR IHBT -ELECTIVES

1. **Laboratory Safety and Techniques**
   - Introduction to laboratory safety protocols and procedures.
   - Training in basic laboratory techniques: pipetting, dilutions, and measurements.
   - Familiarization with specialized endocrinology laboratory equipment.
2. **Hormone Assays and Quantification Techniques**
   - Principles of hormone assays: enzyme-linked immunosorbent assay (ELISA), radioimmunoassay (RIA), and chemiluminescence immunoassay (CLIA).
   - Hands-on hormone quantification using various assays.
   - Data analysis and interpretation of hormone assay results.
3. **Receptor Binding Studies**
   - Introduction to receptor binding assays.
   - Hands-on experience in conducting receptor binding studies.
   - Analysis and interpretation of receptor binding data.
4. **Molecular Techniques in Endocrinology**
   - DNA and RNA extraction techniques.
   - Polymerase chain reaction (PCR) for amplifying specific genes related to endocrinology.
   - Gel electrophoresis and DNA sequencing.
5. **Cell Culture Techniques**
   - Introduction to cell culture methods for studying endocrine cells.
   - Hands-on experience in cell culture: maintenance, transfection, and assays.
   - Analysis of experimental outcomes in cell culture studies.

SEMESTER III

DSCC-VBIOCHEMISTRY

1.Laboratory safety protocols and guidelines.Qualitative Tests for Carbohydrates. Benedict's test for reducing sugars, Molisch's test for the presence of carbohydrates, Iodine test for

starch.Quantitative Analysis of Carbohydrates, Determination of reducing sugars using the Fehling's method.

2.Lipid Extraction and Quantification. Extraction of lipids from biological samples (tissues, cells). Quantification of lipids using gravimetric and colorimetric methods.Analysis of Fatty Acid Composition.

Measurement of lipid peroxidation using thiobarbituric acid reactive substances (TBARS) assay.Isolation of lipoproteins from serum samples.Determination of lipoprotein profiles using gel electrophoresis.

3.Amino Acid Analysis: Quantitative determination of amino acids using chromatographic methods (e.g., HPLC, GC-MS).Enzymatic determination of specific amino acids using colorimetric or spectrophotometric assays.

4. Protein Purification Techniques. Isolation and purification of proteins using methods like chromatography (affinity, ion exchange, size exclusion).Analysis of protein purity using SDS-PAGE.Enzymatic determination of enzyme activity using colorimetric or spectrophotometric assays.Quantitative determination of protein concentrations using methods like Bradford, Lowry, or BCA assays.Interpretation of spectrophotometric results.

DSCC-VI PATHOLOGY

1.Techniques for manual and automated blood cell counting. Enumeration of red blood cells, white blood cells, and platelets. Blood Cell Morphology and Staining

Microscopic examination of blood smears and cell morphology.Staining techniques for blood cell identification (Wright's stain, Giemsa stain).Methods for measuring hemoglobin concentration and hematocrit levels.Study of common hematological disorders (anemia, leukemia, thrombocytopenia).Laboratory tests for diagnosing and monitoring hematological conditions.Coagulation profile tests (PT, APTT) and interpretation.

2. Overview of hematopoiesis: stem cells, bone marrow, and differentiation pathways.Microscopic examination of blood smears.Staining techniques for blood cell identification (Wright's stain, Giemsa stain).Study of erythropoiesis and red blood cell morphology.Identification and classification of different types of anemias.Leukopoiesis and LeukemiasUnderstanding leukocyte development and differentiation. Identification of platelet.

3.Urinalysis and Body Fluid AnalysisMicroscopic examination of urine sediment.

Analysis of other body fluids (cerebrospinal fluid, pleural fluid) and diagnostic significance.

4.Introduction to diagnostic methods and techniques in neuropathology.Specimen preparation and fixation techniques for brain and nervous tissues.

5. Overview of blood transfusion and transplantation in healthcare.Introduction to ABO and Rh blood group systems.Techniques for blood typing and cross-matching. Preparation of different blood components (red cells, platelets, plasma).

ELECTIVES: MICROBIAL BIOCHEMISTRY

1. **Basic Microbiological Techniques, Microbial Growth and Culture,**
   Aseptic techniques in handling microorganisms, Streaking and isolation of bacterial cultures, Gram staining and microscopy, Culture media preparation and sterilization, Growth curve analysis, Measurement of microbial biomass, Biochemical tests for microbial identification, Use of selective and differential media.

2. **Identification of Microorganisms, Enzyme Assays and Kinetics, Metabolic Pathway Studies:** Molecular techniques such as PCR for identification, Isolation and purification of microbial enzymes, Enzyme activity assays, Kinetic studies of microbial enzymes, Carbon metabolism studies (glycolysis, citric acid cycle), Nitrogen metabolism studies (ammonia assimilation, nitrogen fixation), Phosphorus metabolism studies.

3. **Microbial Genetics, Fermentation Techniques, Antimicrobial Susceptibility Testing:** Transformation and gene transfer experiments, Plasmid isolation and analysis, Mutagenesis studies, Fermentation process optimization, Monitoring of key parameters during fermentation, Downstream processing of fermentation products.

4. **Bioinformatics in Microbial Biochemistry, Data Analysis and Interpretation:** Disk diffusion and broth microdilution methods, Determination of Minimum Inhibitory Concentration (MIC), Use of bioinformatics tools for sequence analysis, Comparative genomics and functional annotation, Statistical analysis of experimental data, Interpretation of biochemical and molecular data.

5. **Safety and Ethics in Microbiology, Project Work:**
   Safe handling and disposal of microbial cultures, Adherence to ethical guidelines in microbiological research, Design and execution of a small research project related to microbial biochemistry, Report writing and presentation of findings.

SEMESTER IV

Course Type: DSCC-VII- Molecular Biology & Medical Genetics

a) **Basic Laboratory Skills and Techniques**
   Laboratory safety protocols, Pipetting techniques and accuracy, Dilution calculation.Preparation of reagents and solutions.

b) Nucleic Acid Extraction and Purification
   DNA extraction from various source, RNA extraction and purification, Quality assessment of extracted nucleic acids, DNA amplification principles, Design and optimization of PCR primers, Standard PCR, Agarose gel preparation and casting, DNA and RNA gel electrophoresis , DNA Cloning, Restriction enzyme digestion, Ligation of DNA fragments.

c) **Gel Electrophoresis**

Transformation of bacterial cells, Plasmid purification, Protein Analysis, Protein extraction and purification, SDS-PAGE (Polyacrylamide Gel Electrophoresis)Western blotting, Molecular Tools and Techniques, Southern blotting for DNA analysis, Enzyme-linked Immunosorbent Assay (ELISA).

DSCC-VIII Nutrition & Dietetics

1. **Introduction to Nutrition and Dietary Assessment**
   a)Basic concepts of nutrition and its importance.Analysis and interpretation of dietary data.

   b) **Nutritional Requirements, Menu Planning and Meal Management:** Recommended Dietary Allowances (RDAs) and Dietary Reference Intakes (DRIs),Designing balanced and nutritious menu, Meal planning for different populations (children, elderly, athletes, etc.)

   c) **Medical Nutrition Therapy**
   Nutrition intervention for various medical conditions (diabetes, heart disease, obesity, etc.)Designing therapeutic diets.

DSEP: Hereditary Metabolism System

1. **Introduction to Laboratory Techniques and Safety**
   Laboratory safety protocols and procedures. Basic laboratory techniques: pipetting, dilutions, and measurements. Introduction to laboratory equipment.
2. **Enzyme Assays and Kinetics**
   Principles of enzyme assays. Kinetic analysis of enzymatic reactions. Practical enzyme activity assays related to specific metabolic pathways
3. **Metabolite Analysis Techniques**
   Gas chromatography-mass spectrometry (GC-MS) for metabolic profiling. Liquid chromatography-mass spectrometry (LC-MS) for targeted and untargeted analysis. Interpretation of metabolomics data
4. **Genetic Analysis of Inborn Errors of Metabolism**
   DNA extraction techniques. Polymerase chain reaction (PCR) for amplifying specific gene regions. Gel electrophoresis and DNA sequencing

SEMESTER V

Course Type: DSCP IX- Immunology

1. **Introduction to Immunology, Basic Immunological Techniques, Innate Immunity, Adaptive Immunity**
   a) Introduction to laboratory safety protocols. Pipetting and solution preparation.

   b) Sterilization techniques: autoclaving, UV radiation, filtration. Microscopy: light microscopy and electron microscopy.

   c) Microscopy techniques for immune cell visualization.

d)Hemocytometer counting for cell quantification. Flow cytometry: principles and basic analysis.

e)Immunohistochemistry and immunofluorescence: visualizing immune components in tissues.

f)ELISA (Enzyme-Linked Immunosorbent Assay): quantification of antigens or antibodies.

g)Neutrophil isolation and staining. Macrophage isolation and activation assays.

h)Antibody purification and quantification.

2. **DSCP X- Biotechnology**

Introduction to Biotechnology and Laboratory Safety,Basic Molecular Biology Techniques, Recombinant DNA Technology, Protein Expression and Purification, Cell Culture Techniques

a) Biotechnology applications. Introduction to laboratory safety protocols and equipment handling.
b) DNA extraction from various sources (plant, animal, bacteria). Polymerase Chain Reaction (PCR): setup and optimization. Gel electrophoresis: separation and visualization of DNA fragment.

c) Transformation of competent cells and screening for recombinants.

d) Inducing protein expression and cell harvesting. Protein purification using chromatography techniques. Aseptic techniques and maintaining cell cultures.

Course Type: DSEP- Neurochemistry

1. **Introduction to Laboratory Safety and Equipment, Isolation and Quantification of Neurotransmitters, Receptor Binding Studies:**

- Overview of laboratory safety protocols. Familiarization with basic laboratory equipment used in neurobiochemistry experiments. Tissue homogenization and extraction techniques.
- Quantitative analysis of neurotransmitters using techniques like HPLC or ELISA. Determination of receptor binding affinities. Saturation and competition binding assays using radiolabeled ligands.

2. **Neuroimaging Analysis, Behavioral Experiments:**

- Basics of neuroimaging techniques (MRI, PET).Analysis of neuroimaging data related to brain structure and function.Conducting behavioral experiments in animal models.Correlation of biochemical changes with observed behavioral outcomes.

3. **Neuroprotection Studies Data Analysis and Interpretation:**

- Evaluation of compounds or interventions for neuroprotective effects. Assessment of cellular responses to stress or injury.Statistical analysis of experimental data.Interpretation of results and drawing conclusions from practical experiments.

4. **Safety and Ethical Considerations, Project Work:**

- Continued emphasis on safety protocols, Discussions on ethical considerations in neurobiochemical research.
- Design and execution of a small research project in neurobiochemistry. Presentation and discussion of project findings.

SEMESTER VI

Course Type: DSCP XI - Cancer Biology

1. **Introduction to Cancer Biology and Laboratory Safety, Cell Culture Techniques in Cancer Research, Techniques in Cancer Tissue Analysis, Cancer Genetics and Genomics, Molecular Mechanisms of Tumor Progression**

a) Introduction to laboratory safety protocols and equipment handling. Aseptic techniques and maintaining cancer cell lines.

b) Cell counting, viability assessment, and passaging. Drug testing and response assays.

c) Histopathological techniques for analyzing cancer tissues.
Immunohistochemistry and in situ hybridization.Practical exercises in analyzing tissue samples.Analysis of cancer-related genetic mutations.

d) Practical sessions on DNA sequencing and mutation analysis.

e) Western blotting and protein analysis.

2. **DSCP XII Specialized Tissue Biochemistry**
Introduction to Specialized Tissue Biochemistry, Isolation and Characterization of Cellular Organelles, Protein Extraction and Analysis, Enzyme Kinetics and Inhibition Studies

a) tissue biochemistry and its applications. Importance of tissue-specific biochemical analyses.
b) Techniques for isolating and purifying organelles. Biochemical characterization of organelle components and functions.
c) Extraction methods for proteins from specific tissues. Techniques for protein separation, quantification, and analysis.
d) Enzyme activity assays and kinetic analysis. Study of enzyme inhibitors and their effects on tissue-specific enzymes, mass spectrometry.

Course Type: DSEP- Advanced Immunology

1. **Introduction to Laboratory Techniques in Immunology**

- Overview of laboratory safety and protocols
- Introduction to basic immunological techniques (e.g., pipetting, dilutions)

- Familiarization with laboratory equipment and tools

2. **Flow Cytometry and Cell Sorting Techniques**
   - Principles and applications of flow cytometry
   - Instrument operation and maintenance
   - Single-cell analysis and sorting experiments
3. **ELISA and Western Blotting**
   - Enzyme-Linked Immunosorbent Assay (ELISA): Theory and practice
   - Western blotting techniques for protein analysis
   - Quantification and interpretation of results
6. **Immunohistochemistry and Immunofluorescence**
   - Tissue preparation and fixation
   - Immunohistochemical staining procedures
   - Fluorescence microscopy and image analysis
7. **Molecular Biology Techniques in Immunology**
   - DNA and RNA isolation techniques
   - Polymerase Chain Reaction (PCR) for immunological applications
   - Gene expression analysis and interpretation