FYUGP CURRICULAR FRAMEWORK FOR CLINICAL BIOCHEMISTRY AS MAJOR FOR 2023 & ONWARDS

SEMESTER	COURSE CODE	COURSE TYPE	COURSE TITLE	CREDITS	
				THEORY	PRACTICALS
I	CBC123J	CT-I	**CLINICAL BIOCHEMISTRY:** FUNDAMENTALS OF CLINICAL BIOCHEMISTRY	4	2
II	CBC223J	CT-I	**CLINICAL BIOCHEMISTRY:** CLINICAL PHYSIOLOGY AND DIAGNOSTICS-I	4	2
III	CBC322J	CT-I	**CLINICAL BIOCHEMISTRY:** CLINICAL PHYSIOLOGY AND DIAGNOSTICS-II	4	2
IV	CBC422J1	CT-I	**CLINICAL BIOCHEMISTRY:** CELL BIOLOGY AND ASSOCIATED DISORDERS	3	1
	CBC422J2	CT-II	**CLINICAL BIOCHEMISTRY:** CELL BIOLOGY AND ASSOCIATED DISORDERS	4	2
	CBC422J3	CT-III	**CLINICAL BIOCHEMISTRY:** BIOMOLECULES: METABOLISM AND CLINICAL RELEVANCE-**I**	4	2
V	CBC522J1	CT-I	**CLINICAL BIOCHEMISTRY:** IMMUNOLOGY AND IMMUNOPATHOLOGY	3	1
	CBC522J2	CT-II	**CLINICAL BIOCHEMISTRY:** CELL SIGNALING AND DISORDERS	4	2
	CBC522J3	CT-III	**CLINICAL BIOCHEMISTRY:** BIOMOLECULES: METABOLISM AND CLINICAL RELEVANCE-**II**	4	2
VI	CBC622J1	CT-I	**CLINICAL BIOCHEMISTRY:** MOLECULAR DIAGNOSTICS	3	1
	CBC622J2	CT-II	**CLINICAL BIOCHEMISTRY:** BIOANALYTICAL TECHNIQUES AND INSTRUMENTATION	4	2
	CBC622J3	CT-III	**CLINICAL BIOCHEMISTRY:** MOLECULAR BIOLOGY	4	2
HONOURS MODE					
VII	CBC722J1	CT-I	**CLINICAL BIOCHEMISTRY:** CLINICAL PATHOLOGY	3	1
	CBC722J2	CT-II	**CLINICAL BIOCHEMISTRY:** ORGAN SYSTEM AND ASSOCIATED DISORDERS –I	4	2
	CBC722J3	CT-III	**CLINICAL BIOCHEMISTRY:** ENZYMES: FUNCTION, REGULATION AND DIAGNOSTICS	4	2
VIII	CBC822J1	CT-I	**CLINICAL BIOCHEMISTRY:** MATERNAL AND FETAL HEALTH	3	1
	CBC822J2	CT-II	**CLINICAL BIOCHEMISTRY:** ORGAN SYSTEM AND ASSOCIATED DISORDERS – II	4	2
	CBC822J3	CT-III	**CLINICAL BIOCHEMISTRY:** MEDICAL GENETICS	4	2
HONOURS WITH RESEARCH MODE					
VII	CBC722J1	CT-I	**CLINICAL BIOCHEMISTRY:** CLINICAL PATHOLOGY	3	1
	CBC722J2	CT-II	**CLINICAL BIOCHEMISTRY:** ORGAN SYSTEM AND ASSOCIATED DISORDERS –I	4	2
	CBC722J3	CT-III	**CLINICAL BIOCHEMISTRY:** ENZYMES: FUNCTION, REGULATION AND DIAGNOSTICS	4	2
VIII	CBC822J1	CT-I	**CLINICAL BIOCHEMISTRY:** MATERNAL AND FETAL HEALTH	3	1
	CBC822RP	CT-II	**CLINICAL BIOCHEMISTRY:** PROJECT WITH DISSERTATION	12	

HoD / CONVENOR BOUGS

BACHELORS WITH CLINICAL BIOCHEMISTRY AS MAJOR
1st SEMESTER
CBC123J: CLINICAL BIOCHEMISTRY _ FUNDAMENTALS OF CLINICAL BIOCHEMISTRY
CREDITS: THEORY: 4; PRACTICAL: 2

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

The course is designed to give a general insight into clinical biochemistry as a subject and to acquaint the students with the basic ethics of laboratory, essentials of lab management, quality control and impart awareness about hazards and safety measures in the clinical laboratory. The students will also learn about basics of specimen collection and handling for diagnostic investigations.

(THEORY: 4 CREDITS)

UNIT-1 INTRODUCTION TO CLINICAL BIOCHEMISTRY (15 HOURS)
History and scope of clinical biochemistry, Basic concept of core laboratories, Point of care testing, Automation in clinical laboratories, Ethics of laboratory practice

UNIT-2 QUALITY CONTROL (15 HOURS)
Quality control in clinical biochemistry-Pre-analytical, analytical and post-analytical, Internal and external quality control, Quality controlcharts, Measures of diagnostic accuracy-precision, accuracy, sensitivity, specificity andpredictive values

UNIT-3 LABORATORY HAZARDS AND SAFETY (15 HOURS)
Laboratory hazards- Biological, chemical, radiation and fire hazards; Bio-safety in clinical laboratory-biologicalsafety, chemical safety and radiation safety, Safety equipments, Disposal of hazardous materials

UNIT-4 BODY FLUIDS AND SPECIMENS (15 HOURS)
Specimen collection of blood, urine, feces and other body fluids, Tube additives for blood- usage and mechanism, Handling of specimens- preservation, storage and transport,Pre-analytical variations, Concept of reference values

PRACTICAL (2 CREDITS: 60 HOURS)

1. Biochemical calculations- Molarity, molality, normality and percent solution
2. Preparation of standard buffers and determination of pH of solution
3. Working, principle and maintenance of common laboratory equipments
4. Methods of collection and preservation of blood samples-Colour coding of tubes
5. Fractionation of blood samples

RECOMMENDED BOOKS:

1. Teitz, Fundamentals of Clinical chemistry and Molecular Diagnostics by Nader Rifai. Publisher: Elsevier Publications
2. Clinical Chemistry: Techniques, Principles, Correlations by Michael L. Bishop, Edward P. Fody, Larry E. Schoeff. Publisher: Lippincot Williams & Wilkins
3. Henry's Clinical Diagnosis Management by Laboratory medicine by Richard McPherson, Matthew Pincus. Publisher: Elsevier Publications
4. Medical Laboratory Science · Theory And Practice by J Ochei and A Kolhatka. Publisher: Mc Graw Hill

BACHELORS WITH CLINICAL BIOCHEMISTRY AS MAJOR

2nd SEMESTER

CBC223J CLINICAL BIOCHEMISTRY _ CLINICAL PHYSIOLOGY AND DIAGNOSTICS-I

CREDITS: THEORY: 4; PRACTICAL: 2

Objectives and Expected Learning Outcomes

The student is intended to learn the anatomical and functional aspects of hematology, hepatic, renal system and their associated disorders. The student is expected to describe the diagnostic significance of main laboratory investigations in connection with these disorders. The student will also get acquainted about various lifestyle disorders, their risk factors and their diagnostic investigations.

(THEORY: 4 Credits)

Unit-1: Hepatobiliary System (15 Hours)

Anatomy and physiology of liver, Bile- composition and secretion, Bilirubin-synthesis and degradation, Pathogenesis and diagnosis of Jaundice, Hepatitis and Cirrhosis, Assessment of liver function

Unit-2 Renal System (15 Hours)

Anatomy and physiology of kidney, Ultrastructure of nephron and urine formation, Pathogenesis and diagnosis of Glomerulonephritis and Renal calculi, Assessment of kidney function

Unit-3: Blood System (15 Hours)

Composition, cellular elements and functions of blood, Blood coagulation and coagulation tests- PT, INR, BT, CT, Hematological disorders- Anemia, Leukemia and Hemophilia, Blood Grouping, CBC, Erythrocyte Indices- ESR, HCT, MCH,MCHC

Unit-4: Lifestyle Disorders (15 Hours)

Pathophysiology, risk factors, diagnosis and prevention of Diabetes Mellitus, Obesity, Heart Diseases, Hypertension and Stroke, Glucose estimation- FG, PP, GGT, GDM diagnosis and HbA1c

PRACTICAL (2 Credits: 60 Hours)

1. Liver function tests- ALT and AST
2. Renal function tests- Urea and Creatinine
3. Examination of peripheral blood smear
4. Blood grouping
5. Haemoglobin estimation by Sahli’s method

RECOMMENDED BOOKS:

1. Guyton and Hall Textbook of Medical Physiology by John E. Hall, Michael E. Hall. Publisher: Elsevier Publishers
2. Harrison's Principles of Internal Medicine BY J Larry jameson, Antony S. Fauci, Dennis L. Kasper, Stephen L. Hauser, Dan L. Longo, Joseph Loscalzo. Publisher: Mc Graw Hill Education
3. Teitz, Fundamentals of Clinical chemistry and Molecular Diagnostics by Nader Rifai. Publisher: Elsevier Publications
4. Clinical Chemistry: Techniques, Principles, Correlations by Michael L. Bishop, Edward P. Fody, Larry E. Schoeff. Publisher: Lippincot Williams & Wilkins
5. Hematology for Medical Students by B.S. Shah

BACHELORS WITH CLINICAL BIOCHEMISTRY AS MAJOR
3rd SEMESTER
CBC322J: CLINICAL BIOCHEMISTRY _ CLINICAL PHYSIOLOGY AND DIAGNOSTICS-II
CREDITS: THEORY: 4; PRACTICAL: 2

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

This course encompasses the basic knowledge of endocrinology and the understanding of endocrine disorders as well as their laboratory diagnosis. The student will also learn about the role of vitamins in metabolism and the disorders associated with various vitamin deficiencies.

(THEORY: 4 CREDITS)

UNIT-1: INTRODUCTION TO HORMONES (15 HOURS)

General characteristics and classification of hormones, Difference between enzymes and hormones, Mechanism of hormone Action, Regulation of hormone secretion

UNIT-2: HORMONES-I (15 HOURS)

Physiology and associated disorders of Hypothalamus, Pituitary Gland,Thyroid Gland- Hypo-Hyperthyroidism, Grave's disease, Hashimoto hypothyroidism and Goiter, Thyroid function tests, Adrenal gland- Cushing syndrome, Addison's disease

UNIT-3: HORMONES-II (15 HOURS)

Physiology and associated disorders ofGonadal hormones and Gastro-intestinal hormones, Pancreatic hormones and glucose homeostasis, Parathyroid hormones and calcium homeostasis

UNIT-4: VITAMINS AND DEFICIENCY DISORDERS (15 HOURS)

General Classification of Vitamins, Metabolic role, sources and dietary requirements of Vitamin A,D,E,K,C and B complex vitamins. Disorders associated with vitamin deficiencies

PRACTICAL (2 CREDITS: 60 HOURS)

1. Estimation of Glucose in serum
2. Oral Glucose tolerance test
3. Estimation of Vitamin D level in serum
4. Estimation of Calcium level in serum
5. Estimation of Thyroid hormones-T3, T4, TSH

RECOMMENDED BOOKS:

1. Guyton and Hall Textbook of Medical Physiology by John E. Hall, Michael E. Hall. Publisher: Elsevier Publishers
2. Textbook of Medical Biochemistry by MN Chatterjea and Rana Shinde. Publisher: Jaypee
3. Lippincott Illustrated Reviews Bbiochemistry by Denise R. Ferrier. Publisher: Wolters Kluwer
4. Clinical Chemistry: Techniques, Principles, Correlations by Michael L. Bishop, Edward P. Fody, Larry E. Schoeff. Publisher: Lippincot Williams & Wilkins
5. Harper's Illustrated Biochemistry by Robert K Murray. Publisher: Mc Graw Hill Lange Publications

BACHELORS WITH CLINICAL BIOCHEMISTRY AS MAJOR
4th SEMESTER

CBC422J1: CLINICAL BIOCHEMISTRY _ MEDICAL MICROBIOLOGY

CREDITS: THEORY: 3; PRACTICAL: 1

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

Based on a basic knowledge of biological mechanisms regulating infectious processes, the program will provide a deeper understanding of the field of microbiology. Moreover, they will acquire methodological skills and profound knowledge in infection biology and an understanding of how infectious biological events link people's, animal's and ecosystems health.

***LEARNING OUTCOMES**:*

After completion of the course the student should be able to explain the basic principles of so-called emerging diseases, the concepts of hosts and vectors, pathogen transmission cycles in nature, and general principles to prevent transmission. Identify the most common food- and water-borne pathogens. Identify and analyse the most important infectious diseases

(THEORY: 3 CREDITS)

UNIT-1: INTRODUCTION TO MICROBIOLOGY (15 HOURS)

Historical perspective of microbiology, classification of microorganisms, importance of microorganisms in health and disease, normal human microflora.

UNIT-2: BACTERIOLOGY (15 HOURS)

Bacteria: classification and structure, gram positive and gram-negative bacteria, bacterial culture, growth, growth curve and stages, factors affecting growth, measurement of bacterial growth

UNIT-3: MICROBIAL DISEASES (15 HOURS)

Host-pathogen interaction, pathogenicity, virulence, common bacterial diseases (MTB, Pneumonia), viral diseases (AIDS and COVID). Antibiotics and antivirals; an introduction.

PRACTICALS (1CREDITS: 30 HOURS)

1. Sterilization Techniques.
2. Preparation of Culture Media.
3. Growth of different cultures
4. Staining of Gram positive and gram negative bacteria
5. Antibiotic sensitivity tests.

RECOMMENDED BOOKS:

1. Prescott's Microbiology: Textbook by Christopher J. Woolverton, Joanne M. Willey, and Linda Sherwood.
2. Microbiology: Book by Michael Pelczar and Roger Delbert Reid.
3. Microbiology: An Introduction: Textbook by Gerard J. Tortora

BACHELORS WITH CLINICAL BIOCHEMISTRY AS MAJOR
4th SEMESTER

CBC422J2: CLINICAL BIOCHEMISTRY _ CELL BIOLOGY AND ASSOCIATED DISORDERS

CREDITS: THEORY: 4; PRACTICAL: 2

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles. Students will understand how these cellular components are used to generate and utilize energy in cells. Students will apply their knowledge of cell biology to selected examples of changes or losses in cell function.

LEARNING OUTCOMES

By the end of the semester the students will be able to understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles. Students will understand how these cellular components are used to generate and utilize energy in cells. Students will apply their knowledge of cell biology to selected examples of changes or losses in cell function.

THEORY (4 CREDITS)

UNIT-1: CELLULAR ORGANISATION AND BIO-MEMBRANES (15 HOURS)

Structure of prokaryotic and eukaryotic cell, cell wall structure, Bio-membranes: composition, structure (bilayer-fluid mosaic model) and functions. Membrane transport-active and passive diffusion.

UNIT-2: CELL CYCLE AND ITS REGULATION (15 HOURS)

Overview of cell division – mitosis and meiosis, introduction to cell cycle checkpoints (CDKs and Cyclins). Cytoskeleton: structure and functions, Regulation of cell cycle, cell cycle dysregulation as a cause of cancer initiation.

UNIT-3: CELL ORGANELLES-I (15 HOURS)

Structure and function of Nucleus, Nucleolus, Endoplasmic reticulum, Golgi apparatus and mitochondria. Cell polarization, migration, centriole, cilia and flagella. Disorders: Protein sorting disorders, Mitochondrial diseases, malfunction of nucleus.

UNIT-4: CELL ORGANELLES-II (15 HOURS)

Structure and function of micrtotubules, microfilaments, intermediate filaments, ribosomes, Lysosomes, Peroxisomes. Disorders: Ribosomal disorders, Mad cow disease (BSE), Lysosomal storage disease (LSDs), Zellweger syndrome.

PRACTICALS (2 CREDITS)

1. Preparation and visualisation of Onion cell/peel slide under microscope.
2. Preparation and visualisation of cheek cell slide under microscope.
3. Visualisation of permanent slides of prokaryotic and eukaryotic cell under microscope.
4. Visualisation of permanent slides of different phases of cell division.
5. Differential Centrifugation.

RECOMMENDED BOOKS:

1. Molecular Cell Biology by Harvey Lodish , Arnold Berk , Chris A. Kaiser, Monty Krieger, Anthony Bretscher.
2. Karp's Cell and Molecular Biology:Textbook by Gerald Karp, Janet Iwasa, and Wallace F. Marshall
3. Cell Biology: Organelle Structure and Function by David E Sadava

BACHELORS WITH CLINICAL BIOCHEMISTRY AS MAJOR
4th SEMESTER

CBC422J3: CLINICAL BIOCHEMISTRY _ BIOMOLECULES, METABOLISM AND CLINICAL RELEVANCE-I

CREDITS: THEORY: 4; PRACTICAL: 2

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

To acquaint the students with basic understanding of the structure and properties of macromolecules those interact to maintain and perpetuate the living systems.

EXPECTED LEARNING OUTCOMES

Knowledge on the structure and function of different biomolecules would enable the students to consolidate their focus on understanding various metabolicpathways crucial for the sustenance of living systems.

THEORY (4 CREDITS)

UNIT-I: CHEMISTRY OF CARBOHYDRATES (15 HOURS)

Definition, classification and structure of monosaccharides, disaccharides and polysaccharides. Reducing and non-reducing sugars, Epimers, Cyclic forms, mutarotation. Derivatives of monosaccharaides: (Glycosides, Sugar Acids, Sugar Alcohols and Amino Sugars).

UNIT-II: CARBOHYDRATES METABOLISM AND DISORDERS (15 HOURS)

Glycolysis, Krebs cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogenesis, Glycogenolysis. Lactic acid and Alcoholic fermentation. Inborn errors of carbohydrate metabolism: Glycogen storage Diseases (Type I, II, III, IV, V), Lactose intolerance.

UNIT-III: CHEMISTRY OF LIPIDS (15 HOURS)

Classification, structure, properties and functions of fatty acids, triacylglycerol, phospholipids, sterols, Glycolipids, complex glycolipids and Eicosanoids. Iodine number saponification number.

UNIT IV: LIPID METABOLISM AND DISORDERS (15 HOURS)

Biosynthesis and degradation of saturated and unsaturated fatty acids, ketone bodies and cholesterol. Disorders of lipid metabolism: Lipid storage disease. Plasma Lipoproteins with special biological functions, prostaglandins and leukotrienes.

PRACTICAL (2 CREDITS: 60 HOURS)

6. Qualitative analysis of carbohydrates.
7. Quantitative estimation of Carbohydrates
8. Qualitative analysis of Lipids
9. Quantitative estimation of Lipids
10. Determination of saponification no. and iodine No.
11. Cholesterol estimation

RECOMMENDED BOOKS:

1. Nelson, D. L., and Cox, M.M. Lehninger Principles of Biochemistry, 6th Edition, W.H.Freeman and Company, NY, US2.
2. Lippincott's Illustrated Reviews: Biochemistry" by Denise R. Ferrier.
3. "Biochemistry" by Donald Voet, Judith G. Voet, and Charlotte W. Pratt.
4. Essential Biochemistry" by Charlotte W. Pratt and Kathleen Cornely.
5. Biochemistry and Molecular Biology" by William H. Elliott, Daphne C. Elliott, and Michael J. Tisdale

BACHELORS WITH CLINICAL BIOCHEMISTRY AS MAJOR
5th SEMESTER

CBC522J1: CLINICAL BIOCHEMISTRY _ IMMUNOLOGY AND IMMUNOPATHOLOGY

CREDITS: THEORY: 3; PRACTICAL: 1

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

To acquaint the students with the cellular components of immunology and the disorders associated with the immune system. The practical course will impart hands on skills in basic techniques of immunology and their utility in the diagnosis of human diseases

THEORY: (3 Credits)

UNIT-1: INTRODUCTION TO IMMUNOLOGY (15 HOURS)

History and scope of Immunology, Innate and Adaptive Immunity, Cellular and Humoral Immune response, Cells and organs of immune system, Primary and secondary immune response

UNIT-2: ANTIGENS AND ANTIBODIES (15 HOURS)

Antigens and Immunogens, Properties of immunogens, Epitopes - T and B cell epitopes, Haptens, Structure and functions of antibodies, Monoclonal antibodies, Hybridoma technology, Antigen-antibody reactions, Complement system, Basic concept of Major histocompatibility complex

UNIT-3: IMMUNOPATHOLOGY (15 HOURS)

Autoimmunity and autoimmune disorders- Rheumatoid Arthritis, SLE, Hypersensitivity and its types, Vaccines- active and passive immunization, Immunodeficiencies- primary and acquired, SCID and AIDS

PRACTICAL (1CREDIT: 30 HOURS)

1. Separation of lymphocytes from peripheral blood
2. Qualitative analysis of serum CRP and RF levels
3. Demonstration of precipitation reaction by Ouchterlony diffusion Technique
4. Demonstration of ELISA

RECOMMENDED BOOKS:

1. Kuby Immunology by Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby. Publisher W. H. Freeman.
2. Cellular and Molecular Immunology by Abul K. Abbas. Andrew H. Litchman, Shiv Pillai.Publisher: Elsevier
3. Immunology; An Introduction. By Ian Tizard. Publisher: Saunders Publication
4. Fundamental Immunology by William E. Paul. Publisher: Lippincot William and Wilkins

BACHELORS WITH CLINICAL BIOCHEMISTRY AS MAJOR

5th SEMESTER

CBC522J3: CLINICAL BIOCHEMISTRY _ BIOMOLECULES, METABOLISM AND CLINICAL RELEVANCE-II

CREDITS: THEORY: 4; PRACTICAL: 2

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

To acquaint the students with basic understanding of the structure and properties of macromolecules that interact to maintain and perpetuate the living systems. Knowledge on the structure and function of different biomolecules would enable the students to consolidate their focus on understanding various metabolic pathways crucial for the sustenance of living systems.

THEORY (4 CREDITS)

UNIT-I CHEMISTRY OF AMINO ACIDS AND PROTEINS (15 HOURS)

Structure, classification, properties and functions of amino acids. Protein Structure: Primary, secondary, tertiary and quaternary structure.

UNIT-II AMINO ACID METABOLISM AND DISORDERS (15 HOURS)

Amino acid Synthesis: Transamination, deamination reactions, urea cycle, degradation of amino acids like tryptophan, tyrosine. Inborn errors of amino acid metabolism: Phenylketonuria, Albinism, Alkaptonuria, Maple Syrup Urine Disease.

UNIT-III CHEMISTRY OF NUCLEIC ACIDS (15 HOURS)

Structure and properties of purines and pyrimidine bases, nucleoside and nucleotides, Structure of dsDNA, Conformations of DNA. Structural organization of DNA.

UNIT-IV: NUCLEOTIDE METABOLISM AND DISORDERS (15 HOURS)

Biosynthesis and degradation of purines and pyrimidines; Regulation of purines and pyrimidine biosynthesis, Disorders of purine / Pyrimidine metabolism. Errors of Nucleotide metabolism: adenosine deaminase deficiency, Gout, LeshNyhan Syndrome,

PRACTICAL (2 CREDITS: 60 HOURS)

1. Qualitative analysis of Amino acids
2. Quantitative estimation of proteins by Lowry method.
3. Quantitative estimation of proteins by spectrophotometer.
4. Quantitative estimation of DNA by DPA method.
5. Quantitative estimation of DNA by spectrophotometer.

RECOMMENDED BOOKS:

1. Nelson, D. L., and Cox, M.M. Lehninger Principles of Biochemistry, 6th Edition, W.H.Freeman and Company, NY, US2.
2. Lippincott's Illustrated Reviews: Biochemistry" by Denise R. Ferrier.
3. "Biochemistry" by Donald Voet, Judith G. Voet, and Charlotte W. Pratt.
4. Essential Biochemistry" by Charlotte W. Pratt and Kathleen Cornely.
5. Biochemistry and Molecular Biology" by William H. Elliott, Daphne C. Elliott, and Michael J. Tisdale

BACHELORS WITH CLINICAL BIOCHEMISTRY AS MAJOR

5th SEMESTER

CBC522J2: CLINICAL BIOCHEMISTRY _ CELL SIGNALING AND DISORDERS

CREDITS: THEORY: 4; INTERNSHIP / PRACTICAL: 2

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

To acquaint students about the fundamental principles of cell signaling pathways. This includes learning about different types of signaling molecules, receptors, and the various components involved in transmitting signals within and between cells.

THEORY (4 Credits)

UNIT-I: INTRODUCTION TO CELL SIGNALING (15 HOURS)

Overview of cell communication and signal transduction. Components of signaling pathways: ligands and receptors, cell surface and intracellular receptors. Types of cell Signaling: autocrine, paracrine, endocrine, and juxtracrine.

UNIT-II: CELL SURFACE RECEPTORS (15 HOURS)

Structure and function of G-protein-coupled receptors (GPCRs), receptor tyrosine kinases (RTKs) and ion channels. Ligands utilizing GPCR pathway.

UNIT-III: INTRACELLULAR RECEPTORS (15 HOURS)

Diversity and significance of protein kinases and Phosphatases, MAPKs, PKCs, CAMKs. Intracellular receptor signaling. Signaling pathways involved in cell growth, proliferation and gene expression.

UNIT-IV: CELL SIGNALING DISORDERS (15 HOURS)

Dysregulation of signaling pathways in cancer and oncogenes. Signaling abnormalities in neurological disorders (Alzheimer's and Parkinson's), Insulin Signaling disorders: Type 2 diabetes mellitus.

INTERNSHIP OR PRACTICAL (2 CREDITS: 60 HOURS)

1. Monitoring blood glucose levels over a month in diabetic patients.
2. Virtual demonstration of signaling pathways.
3. Preparation of models/ presentations on signalling pathways.
4. Quantitative estimation of proteins by spectrophotometer.
5. Demonstration of Western blotting vis a vis cell signalling pathways.

RECOMMENDED BOOKS:

1. Molecular Biology of the Cell" by Bruce Alberts, Alexander Johnson, Julian Lewis, et al.
2. Cell Signaling and Signal Transduction: Implications for Disease" by Maurice J. B. van den Hoff, Eddy W. R. van der Giessen, and Peter L. Hordijk.
3. Principles of Cell Signaling" by Lewis C. Cantley, Tony Hunter, and Tony Pawson.
4. Cell Signaling" by John T. Hancock and Tony Pawson.
5. Signal Transduction" by Ijsbrand M. Kramer and Hans R. Bos

BACHELORS WITH CLINICAL BIOCHEMISTRY AS MAJOR
6th SEMESTER

CBC622J1: CLINICAL BIOCHEMISTRY _ MOLECULAR DIAGNOSTICS

CREDITS: THEORY: 3; PRACTICAL: 1

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

To acquaint the students with the developments in the field of Molecular diagnostics. The student will learn how variations in the genome are used for detection of various diseases and infection pathogens.The practical course will impart hands on skills in basic techniques of Molecular diagnostics, Nucleic acid isolation and their utility in the diagnosis of human diseases

THEORY (3 CREDITS)

UNIT-1: NUCLEIC ACID ISOLATION FOR NAT ASSAYS (15 HOURS)

Land mark developments in Molecular Biology and genetics, Nucleic acid chemistry, Genetics and Epigenetics, Nuclear and Mitochondrial genomes, Nucleic acid Isolation (DNA, RNA, Assessment of Nucleic acid yeild and quality), The human genome Project

UNIT-2: NUCLEIC ACID TECHNIQUE (NAT) ASSAYS (15 HOURS)

Nucleic acid variations to be used: alterations in human, baterial and viral genomes, Amplification Techniques: Target amplification (PCR), other approaches to amplification, Endpoint quantification in amplification assays, Visualization of Nucleic acids – Detection techniques (reporter molecules and labelled probes), Hybridization assays – Real-time PCR, Melting analysis, SNP genotyping/RFLP.

UNIT-3: APPLIED MOLECULAR DIAGNOSTICS (15 HOURS)

Lymphoma specific chromosomal translocations analysis (by PCR and Southern Blot), Autosomal recessive and dominant diseases, X-linked diseases, Forensic DNA typing – genetic variations useful in Identity testing, HLA typing for Transplantation, Parentage testing, Molecular assays for Infectious diseases – choice of specimen to test, NAT to be used, Human Immunodeficiency virus Type 1 (HIV-1), Hepatitis C Virus, SARS-COV-2 virus

PRACTICAL (1CREDIT: 30 HOURS)

1. Isolation of DNA from peripheral blood
2. Isolation of RNA from peripheral blood
3. Target amplification by PCR
4. RFLP

RECOMMENDED BOOKS:

1) Teitz, Fundamentals of Clinical chemistry and Molecular Diagnostics by Nader Rifai. Publisher: Elsevier Publications
2) Clinical Chemistry: Techniques, Principles, Correlations by Michael L. Bishop, Edward P. Fody, Larry E. Schoeff. Publisher: Lippincot Williams & Wilkins
3) Molecular Cell Biology. Harvey Lodish, Arnold Berk, Chris A. Kaiser Monty Krieger, Anthony Bretscher W H Freeman & Co.
4) Cell and Molecular Biology: Concepts and Experiments. Karp. John Wiley& Sons. Inc.
5) Biochemistry and Molecular Biology" by William H. Elliott, Daphne C. Elliott, and Michael J. Tisdale

BACHELORS WITH CLINICAL BIOCHEMISTRY AS MAJOR
6th SEMESTER
CBC622J2: CLINICAL BIOCHEMISTRY _ BIOANALYTICAL TECHNIQUES AND INSTRUMENTATION
CREDITS: THEORY: 4; PRACTICAL: 2

OBJECTIVES

To provide basic understanding of the theory and practice of bio-analytical techniques and diagnostic tools; and the detailed interpretation of their results.

LEARNING OUTCOMES

Successful completion of this course would enable the students
To be able to use analytical techniques and understand the working of diagnostic tools; To understand the strengths, limitations and creative use of bio-analytical and diagnostic techniques

THEORY (4 CREDITS: 60 HOURS)

UNIT I: CENTRIFUGATION (15 HOURS)

Basic principle of centrifugation: RCF, sedimentation velocity and sedimentation coefficient. Types of centrifuges and rotors. Preparative and analytical centrifugation. Principle and application of differential centrifugation, density gradient centrifugation.

UNIT II: CHROMATOGRAPHY (15 HOURS)

Basic principle of chromatography. Paper and Thin Layer, Column: Principle and applications of Size exclusion, Affinity, Ion-exchange chromatography and High Performance Liquid Chromatography (HPLC).

UNIT III SPECTROSCOPY AND MICROSCOPY (15 HOURS)

Basic principles of spectroscopy, Beer-Lambert's Law.Principle, instrumentation and applications of UV-Visible spectrophotometry. Principle, working & applications of light, Fluorescence microscopy and Phase contrast Microscopy. Scanning and transmission electron microscope (Basic concept).

UNIT IV: IMAGING TECHNIQUES (15 HOURS)

Principles and applications of X-ray, Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET) scan and ECG.Radioactivity and radioisotopes, radioactive decay. Radioisotopes use in biology – principles, Instrumentation and applications.

PRACTICALS (2 CREDITS: 60 HOURS)

1. Separation of mononuclear cells by Ficoll-Hypaque method using centrifugation.
2. Separation of mixture amino acids by Paper and Thin layer chromatography.
3. Separation of mixture sugars by Paper and Thin layer chromatography.
4. Demonstration of Beer Lambert's law.
5. Study of Cell structure using light microscope (Permanent slides)
6. Demonstration of ECG

RECOMMENDED BOOKS:

1. Principles and Techniques Biochemistry; Molecular Biology. Wilson & Walker. Cambridge University Press.
2. Biochemistry Laboratory: Modern Theory and Techniques. Rodney F. Boyer. Pearson.
3. Chromatography: Basic Principles, Sample Preparations and Related Methods by Elsa Lundanes, Leon Reubsaet, TygeGreibrokk WILEY.
4. Physical Biochemistry. Freifelder, D. W.H. Freeman and Co., N.Y.USA.
5. Fundamentals of Light Microscopy and Electronic Imaging. Douglas B. Murphy. John willey and sons, Inc.

BACHELORS WITH CLINICAL BIOCHEMISTRY AS MAJOR
6th SEMESTER
CBC622J3: CLINICAL BIOCHEMISTRY _ MOLECULAR BIOLOGY
CREDITS: THEORY: 4; PRACTICAL: 2

OBJECTIVES

To provide the basic understanding of nucleic acids as genetic material, their structural and functional organisation. The practical course will impart hands on training in basic techniques of DNA isolation, PCR and nucleic acid estimation.

EXPECTED LEARNING OUTCOMES

Successful completion of this course would enable the students to understand central dogma of molecular biology spanning from DNA Replication to gene expression, understand the molecular aspects of the biology, identify and distinguish genetic regulatory mechanism at different levels

UNIT I: DNA STRUCTURE (15 HOURS)

DNA as a genetic material (experimental evidences), Structural features of double helix. Conformational forms of DNA, C-value paradox. Denaturation and renaturation of DNA, Cot Curve. Organization of prokaryotic and eukaryotic Chromosomes.

UNIT II: DNA REPLICATION & REPAIR (15 HOURS)

Structure and function of various prokaryotic (DNA Pol I, Pol II & Pol III holoenzyme) and eukaryotic DNA polymerases. Mechanism of replication in prokaryotes and eukaryotes, Semi-conservative nature of DNA replication, Rolling circle replication, Fidelity of replication. Mechanism of DNA repair - an introduction.

UNIT III: TRANSCRIPTION (15 HOURS)

Fine structure of genes in eukaryotes and prokaryotes, Structure and types of RNA. Structure, types and functions of Prokaryotic and Eukaryotic RNA polymerases, Mechanism of transcription in Prokaryotes and Eukaryotes. Transcription inhibitors. Operon concept (Lac operon). RNA processing - an overview.

UNIT IV: TRANSLATION (15 HOURS)

Genetic code and its features. Wobble hypothesis. Ribosome structure and assembly, Structure of tRNA and charging of tRNAs. Mechanism of translation in Prokaryotes and Eukaryotes, Translational inhibitors. Post translational modifications of proteins.

PRACTICALS (2 CREDITS: 60 HOURS)

1. Isolation of genomic DNA from blood.
2. Isolation of chromosomal DNA from bacterial cells.
3. Quantitative estimation of DNA by spectrophotometry.
4. Agarose gel Electrophoresis of DNA
5. Demonstration of thermal cycler and PCR.

RECOMMENDED BOOKS:

1. Molecular Biology of the Gene. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R. Cold Spring Harbour Lab. Press, Pearson Pub.
2. Molecular Biology by Robert F Weaver: McGraw-Hill Higher Education.
3. The Cell: A Molecular Approach. Cooper, G.M. and Hausman, R.E.ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Genes. Goldstein, Kilpatrick, Krebs. Lewin's Jones & Bartlett Publishers.
5. Molecular Cell Biology. Harvey Lodish, Arnold Berk, Chris A. Kaiser Monty Krieger, Anthony Bretscher W H Freeman & Co.
6. Cell and Molecular Biology: Concepts and Experiments. Karp. John Wiley& Sons. Inc.

Semester: 1st -3rd

MULTIDISCIPLINARY COURSE

CBC022I: CLINICAL BIOCHEMISTRY (Clinical Nutrition & Health)

Credits: 03

Objectives and Expected Learning Outcomes:

To acquaint the students with the concept of nutrition associated disorders and the assessment methods involved. The student will learn the assessment of nutrition status by various indices and their applicability in social and family health. The students will get acquainted with the management of nutrition related disorders.

Unit I: Minerals and Vitamins

Vitamins: classification, function and disease associated with vitamins. Minerals and ions: Requirement, function and biological importance of Calcium, Iron, Iodine, Zinc, Phosphorus, Copper, Sodium and Potassium; Deficiency diseases of minerals like calcium, zinc, iodine and iron.

Unit II: Clinical Nutrition

Introduction to nutrition, relation between good nutrition and health. Assessment of nutritional status - Anthropometric measurements and indices, body mass index, dietary reference intake; macro- and micro-nutrients as biochemical markers of nutritional imbalance. Breast Feeding, Women's health. Infant, Child, adolescent and Geriatric health.

Unit III: Nutritional Disorders & Management

Concept of Malnutrition and Over-nutrition: protein Energy Malnutrition. Chronic energy deficiency in Women. Obesity: Aetiology, Secondary causes. Appetite and its management. Fasting disorders: Anorexia Nervosa, Bulimia Nervosa. Diet in the aetiology of disease. Dental caries, Cancer.

Recommended Books:

1. Clinical Biochemistry: metabolic and Clinical Aspects by William J Marshal.
2. Nutrition in Promoting the Public Health by Mildred Kaufman.

BACHELORS WITH CLINICAL BIOCHEMISTRY AS MAJOR

7th SEMESTER

CBC722J1: CLINICAL BIOCHEMISTRY _ CLINICAL PATHOLOGY

CREDITS: THEORY: 3; PRACTICAL: 1

OBJECTIVES

To provide basic understanding of diseases, their pathogenesis and basic techniques involved in preparation and investigation of disease tissue.

LEARNING OUTCOMES

At the end of the course students will be able to

- *Learnthe molecular mechanisms of cell damage, cell response (cellular stress, necrosis, apoptosis) and organism response to the damage (inflammation).*
- *Learn various histotechniques, handling, processing, cutting of paraffin and frozen tissue specimens as well as staining procedures.*

UNIT I: GENERAL PATHOLOGY (15 HOURS)

Introduction and history of clinical pathology. Types, Causes & Mechanism of cell injury, necrosis and apoptosis.Mechanism ofacute and chronic inflammation.Granuloma formation. Tissue repair.

UNIT II: HEMODYNAMIC DISORDERS (15 HOURS)

Hyperaemia and congestion- definition and morphology, Pathophysiology and clinical features of Thrombosis, Embolism, Shock, Infarction and Oedema. Transudate and Exudate.

UNIT III: HISTOPATHOLOGICAL TECHNIQUES (15 HOURS)

Introduction to histopathology. Collection, handling and storage of tissue specimens, Basic concepts of fixation and fixatives, Tissue processing: manual and automated methods, safety measures in histopathology lab.

PRACTICALS (1 CREDIT: 30 HOURS)

1. Demonstration of equipments used in histopathology lab.
2. To prepare a slide for histological analysis.
3. Demonstration of H & E staining.
4. To perform Immunohistochemical staining.

RECOMMENDED BOOKS:

1. Clinical pathology, haematology and blood banking by Maheshwari-Jay Kay
2. Clinical pathology by James Carton and Richard Daly- OUP Oxford
3. Essentials of clinical pathology by Shirish M. Kawthalkar-JPB
4. Quick Compendium of Clinical Pathology by Daniel D. Mais, ASCP Press.

BACHELORS WITH CLINICAL BIOCHEMISTRY AS MAJOR
7th SEMESTER
CBC722J2: CLINICAL BIOCHEMISTRY _ ORGAN SYSTEMS AND ASSOCIATED DISORDERS-I
CREDITS: THEORY: 4; PRACTICAL: 2

OBJECTIVES

This course will help to demonstrate knowledge and understanding of major body systems, with the corresponding changes in organs affected by disease and fundamental knowledge related to health.

LEARNING OUTCOMES

Successful completion of this course would enable the students to understand the structure and architecture of major human organs and explain their role in the maintenance of health in individuals and the most important clinical signs and symptoms, structural changes and laboratory findings associated with a specific organ system disease.

UNIT I- HEPATOBILIARY SYSTEM - PHYSIOLOGY & DISORDERS (15 HOURS)

Structure, anatomy and physiology of liver- Bilirubin metabolism and bile secretion, Diseases of hepatobiliary system - acute and chronic liver diseases: Jaundice, viral and toxic hepatitis, Non-alcoholic fatty liver disease, liver cirrhosis. Biochemical indices in hepatobiliary disorders.

UNIT II- GASTROINTESTINAL SYSTEM- PHYSIOLOGY & DISORDERS (15 HOURS)

Structure, anatomy and physiology of digestive system: Digestion and absorption of Carbohydrates, proteins and fats. Phases of digestion. Digestive hormones. Digestive system disorders: Irritable bowel syndrome, Peptic ulcers, lactose intolerance, Crohn's disease. Small bowel malabsorption tests, Xylose test.

UNIT III- CARDIOVASCULAR SYSTEM - PHYSIOLOGY & DISORDERS (15 HOURS)

Structure, anatomy and physiology of heart, cardiac cycle (cardiac output, venous return and their regulation), Disorders of cardiovascular system: Myocardial Infarction, congestive heart failure, Atherosclerosis, Shock and Hypertension. Hematopoiesis, Hemostasis, Blood disorders- Anemia and bleeding disorders.

UNIT IV- RENAL SYSTEM - PHYSIOLOGY & DISORDERS (15 HOURS)

Structure, anatomy and physiology of kidneys, anatomy of Nephron, Urine formation, Disorders of renal system: Glomerulonephritis, Nephrotic syndrome, renal calculi, acute/chronic renal failure. Tests of kidney function: GFR, Clearance tests (creatinine and inulin clearance), plasma creatinine, urea, Urinalysis.

PRACTICALS (2 CREDITS: 60 HOURS)

1. Lipid Profile (TG, Cholestrol, HDL, and LDL)
2. Kidney Function Test (Urea, Creatinine, Uric Acid)
3. Liver Function Test (AST, ALT, ALP), Bilirubin estimation (Direct and Indirect)
4. Blood pressure monitoring by Sphygmomanometer
5. Urinanalysis: Tests for detection of Protein, Reducing substances and Ketone bodies

RECOMMENDED BOOKS:

1. Harrison's Principles of Internal Medicine, 18thEdition (Harrison's Principles of Internal medicine) by Dan L. Longo, Anthony S. Fauci, Dennis L. Kasper, Stephen L. Hauser, J. Larry Jameson and Joseph Loscalzo, McGrawhills publishers
2. Textbook of Medical Physiology by John E. Hall, Guyton and Hall, Saunders.
3. Principles of Anatomy & Physiology by Tortora, G.J. & Grabowski, S. John wiley & sons,Inc.
4. Frederic Martini, Fundamentals of Anatomy and Physiology (prentice Hall, New Jersey)
5. Clinical Biochemistry: Metabolic And Clinical Aspects by William J. Marshall, Stephan K. Bangert, Elizabeth S.M.; Elsevier Science Health Science
6. Fundamentals of clinical chemistry – Teitz, W.B.Saunders company
7. Practical clinical biochemistry, volume I and II, by Varleyet.al., CBS Publishers,
8. Clinical Chemistry – principles, procedures and correlations, Bishop, Lipppincott.

BACHELORS WITH CLINICAL BIOCHEMISTRY AS MAJOR

7th SEMESTER

CBC722J3: CLINICAL BIOCHEMISTRY _ ENZYMOLOGY - FUNCTION, REGULATION AND DIAGNOSTICS

CREDITS: THEORY: 4; PRACTICAL: 2

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

To acquaint the students with the basic knowledge of enzymology. The course also emphasizes on the role of enzymes in the diagnosis of various human diseases. The student will be able to understand, describe and integrate the basic theoretical and diagnostic aspects of enzyme in relation to various organ system diseases.

THEORY: (4 CREDITS)

UNIT-1: INTRODUCTION TO ENZYMES (15 HOURS)

Historical background of enzymes, Nomenclature and classification of enzymes, Coenzymes and cofactors, Mechanism of enzyme action, Active site, Factors affecting enzyme activity**.** Isoenzymes and multienzyme complexes.

UNIT-2: ENZYMES KINETICS (15 HOURS)

Determination of Michaelis Menten equation for uni-substrate enzyme, Determination of Km and V_{max}, Line Weaver-Burk plot, Mechanism of catalysis- Acid base, electrostatic, covalent and enzyme catalysis**,** Role of coenzymes in enzyme catalysis-$NAD^{+/}NADP^{+}$, FMN/FAD, Adenosine phosphatases, TPP, Coenzyme A, Pyridoxal phosphate.

UNIT-3: ENZYME REGULATION AND INHIBITION (15 HOURS)

Definition and types of inhibition, Reversible- competitive, uncompetitive, non-competitive and Irreversible inhibition. Regulation of Enzyme activity- Allosteric regulation and covalent modification, feedback inhibition

UNIT-4: DIAGNOSTIC ENZYMOLOGY (15 HOURS)

Principles and definition of functional and non-functional plasma enzymes, Enzyme pattern in health and disease with special mention of – serum transaminases, Alkaline phosphatase, Gamma glutamyl transpeptidase, Acid phosphate, Creatine Kinase, Cholinesterase, Lactate Dehydrogenases, Amylase and Plasma lipase. Significance of enzymes in malignancies

PRACTICAL (2 CREDITS: 60 HOURS)

1. Assay of alkaline phosphates activity.
2. Effect of substrate concentration on alkaline phosphates activity and determination of its Km
3. Effect of pH on enzyme activity and determination of optimum pH
4. Isoenzyme separation by Gel electrophoresis.

RECOMMENDED BOOKS:

1. Enzymes: Biochemistry, Biotechnology, Clinical Biochemistry by Trevor Palmer, Philip L Bonner. Publisher: Horwood Publishing Limited.
2. Lehninger Principles of Biochemistry by D.L. Nelson and Cox, Publisher: W.H. Freeman and Co.
3. Biochemistry by Lubert Styrer. Publisher: W.H. Freeman.
4. Biochemistry by Donald Voet and Judith G. Voet. Publisher: Wiley.
5. Teitz, Fundamentals of Clinical chemistry and Molecular Diagnostics by Nader Rifai. Publisher: Elsevier Publications

BACHELORS WITH CLINICAL BIOCHEMISTRY AS MAJOR

8th SEMESTER

CBC822J1: CLINICAL BIOCHEMISTRY _ MATERNAL AND FETAL HEALTH

CREDITS: THEORY: 3; PRACTICAL: 1

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

To acquaint the students with the physiology of pregnancy, basic health standards of expecting women, physical signs that indicate some complications of pregnancy that may require clinical consultation. The student will learn how babies develop in the womb and what is importance of pre and post natal care of newborn. The practical course will impart hands on life skills in basic knowhow of motherhood and nurturing of newborns.

THEORY (3 CREDITS)

UNIT-1 GENERAL WELL BEING OF EXPECTANT WOMEN (15 HOURS)

Understanding the importance of well-being during pregnancy, General health assessment, Evaluation of overall health - including Height, weight, BP & general physical condition, Hormonal assessment: Evaluation of hormone levels: TSH, FSH, progesterone, Blood tests: Assessing CBC, WBC, RBC, Hb levels, Blood type & Rh factor, Blood Glucose test, Nutritional Assessment: - Assessment of nutritional status including iron levels, Vit.D/folate/folic acid levels.

UNIT-2 SAFE PREGNANCY MEASURES (15 HOURS)

Benefits of exercise and nutrition during pregnancy, Stress management during pregnancy.Pregnancy complications: Ectopic pregnancy, gestational T2DM, preclampsia, pregnancy induced hypertension, Placental abnormalities, low lying placenta, placenta previa, Some management strategies related to pregnancy complications.

UNIT-3 INTRODUCTION TO FETAL DEVELOPMENT (15 HOURS)

Overview of prenatal development, Stages of prenatal development.Factors affecting fetal health; Impact of lifestyle choices (Smoking, alcohol, drugs) on fetal development, Importance of prenatal care, Diagnostic techniques for assessing fetal health, Prenatal Screening,Non-invasive prenatal testing (NIPT), Common fetal health conditions:-Birth defects and congenital anomalies, Fetal growth restriction, Intrauterine growth retardation (IUGR).

PRACTICAL (1CREDIT: 30 HOURS)

1. Blood Grouping
2. How to do basic Anthropometry
3. Stress management – Deep breathing and relaxation techniques
4. Basic knowledge of neonatal care

RECOMMENDED BOOKS:

1. Harrison's Principles of Internal Medicine, 18thEdition (Harrison's Principles of Internal medicine) by Dan L. Longo, Anthony S. Fauci, Dennis L. Kasper , Stephen L. Hauser, J. Larry Jameson and Joseph Loscalzo, McGrawhills publishers
2. Textbook of Medical Physiology by John E. Hall, Guyton and Hall, Saunders.
3. Principles of Anatomy & Physiology by Tortora, G.J. & Grabowski, S. John wiley & sons,Inc.
4. Teitz, Fundamentals of Clinical chemistry and Molecular Diagnostics by Nader Rifai. Publisher: Elsevier Publications.

BACHELORS WITH CLINICAL BIOCHEMISTRY AS MAJOR
8th SEMESTER
CBC822J2: CLINICAL BIOCHEMISTRY _ ORGAN SYSTEMS AND ASSOCIATED DISORDERS-II
CREDITS: THEORY: 4; PRACTICAL: 2

OBJECTIVE:

This course will help to explain the physiological role of hormones, nervous and musculoskeletal systemsin maintaining homeostasis, integrating growthand relating them whenever possible to human disorders.

LEARNING OUTCOMES:

Successful completion of this course would enable the students to understand:

- *The classification of the hormones, their physiological role in achieving homeostasis. Pathogenesis, morphological changes and the complications associated with the disruption of endocrine function.*
- *The structure, architecture and associated disorders of neuro-muscular system and explain their role in the maintenance of health in individuals.*

UNIT I: ENDOCRINE SYSTEM -I, PHYSIOLOGY & DISORDERS (15 HOURS)

General characters and classification of hormones; Hypothalamus, Pituitary gland, Thyroid gland and Parathyroid gland: Structure and physiological role of the hormones secreted. Pathophysiology and clinical features of Hypo- and hyper-secretion of hormones secreted by hypothalamus, pituitary, thyroid and parathyroid glands.

UNIT II: ENDOCRINE SYSTEM –II, PHYSIOLOGY & DISORDERS (15 HOURS)

Adrenal gland hormones: Structure and physiological role of hormones secreted from Adrenal medulla and cortex. Pancreatic gland: structure andphysiological role of pancreatic hormones, Structure and functions of hormones secreted by gonads. Pathophysiology and clinical features of Hypo- and hyper- secretion of hormones secreted by adrenal gland, pancreas and gonads.

UNIT III: MUSCULO-SKELETAL SYSTEM - PHYSIOLOGY AND DISORDERS (15 HOURS)

Structure and Physiology of cardiac, smooth and skeletal muscles. Molecular mechanism of muscle contraction; Joints:Structure and physiology; Synovial fluid and its properties; Pathophysiology, clinical features and laboratory findings of Musculo-Skeletal disorders: Tetany, Osteoporosis, Osteoarthritis and Rheumatoid Arthritis.

UNIT IV: NERVOUS SYSTEM - PHYSIOLOGY AND DISORDERS (15 HOURS)

Structure, anatomy and physiology of CNS & PNS, Structure of neuron, Physiology of nervous system: Mechanism of Nerve impulse conduction. Neurotransmitters: Excitory and Inhibitory neurotransmitters, Neurological disorders: Alzheimer's, Parkinsons disorders and Multiple sclerosis.

PRACTICALS (2 CREDITS: 60 HOURS)

1. Estimation of T3, T4, and TSH by ELISA/RIA
2. Investigations in Diabetes Mellitus (blood glucose, HbA1c)
3. Detection and estimation of rheumatoid factor and C reactive protein
4. Estimation of Ca^{++} and Mg^{++}
5. Estimation of Vit D levels

SUGGESTED READINGS:

1. Harrison's Principles of Internal Medicine, 18thEdition (Harrison's Principles of Internal medicine) by Dan L. Longo, Anthony S. Fauci, Dennis L. Kasper , Stephen L. Hauser, J. Larry Jameson and Joseph Loscalzo, McGrawhills publishers
2. Textbook of Medical Physiology by John E. Hall, Guyton and Hall, Saunders.
3. Principles of Anatomy & Physiology by Tortora, G.J. & Grabowski, S. John wiley & sons,Inc.
4. Frederic Martini, Fundamentals of Anatomy and Physiology (prentice Hall, New Jersey)
5. Clinical Biochemistry: Metabolic And Clinical Aspects by William J. Marshall, Stephan K. Bangert, Elizabeth S.M.; Elsevier Science Health Science
6. Fundamentals of clinical chemistry – Teitz, W.B.Saunders company
7. Practical clinical biochemistry, volume I and II, 5th Edition – Varleyet.al., CBS Publishers, Physiological basis of Medicine (Best & Taylor)
8. Clinical Chemistry – principles, procedures and correlations, Bishop, Lippincott.

BACHELORS WITH CLINICAL BIOCHEMISTRY AS MAJOR
8th SEMESTER

CBC822J3: CLINICAL BIOCHEMISTRY _ MEDICAL GENETICS

CREDITS: THEORY: 4; PRACTICAL: 2

OBJECTIVE:

- *To explain the basic principles of genetics and chemical basis of heredity and to introduce the concept of epigenetics as a key mechanism of regulation of gene expression and also to discuss the role of epigenetics in diseases.*

LEARNING OUTCOMES

At the end of the course students will be able to describe the phenotypic classes and their ratios from a monohybrid cross involving dominant and recessive alleles, recognize that epigenetic mechanisms affect gene expression, recognize that epigenetic problems can result in human diseases including cancer

UNIT I: INTRODUCTION TO GENETICS (15 HOURS)

Mendel and his experiments. Laws of inheritance. Chromosomal basis of segregation and independent assortment.Test and back cross, incomplete dominance, co-dominance, pleitropy, multiple allelism, polygenic inheritance, epistasis, penetrance and expressivity with examples. Extrachromosomal inheritance & importance

UNIT II: GENETICS IN MEDICAL PRACTICE -I (15 HOURS)

Genetic principles and their application in medicalpractice; Case studies (Interacting with patients, learning family history and drawingpedigree chart); Pedigrees- gathering family history, pedigree symbols, construction of pedigrees; Monogenic traits - Autosomal inheritance-dominant and recessive; Sex-linked inheritance-dominant and recessive; Sex-limited and sex-influenced traits; Y-linked

UNIT III: GENETICS IN MEDICAL PRACTICE -II (15 HOURS)

Syndromes and disorders: Definition and their genetic basis. Types of mutation, mutagens - physical and chemical, detection of mutations. Structural and numerical aberration of chromosomes. Hereditary defects– (Klinefelter, Turner, Cri-du-chat, and Downs syndromes, Cystic fibrosis and TaySach's Syndrome).

UNIT III: EPIGENETICS IN HEALTH AND DISEASE (15 HOURS)

Chromatin structure, Histone modifications and their roles in gene expression, chromatin-remodeling complexes, Histone modifications in cancer & metabolic diseases. DNA methylation. Significance of hypomethylation and hypermethylation, Regulation of eukaryotic gene expression by long non-coding RNAs, and miRNAs, Aberrant DNA methylations in cancer& metabolic diseases.

PRACTICALS (2 CREDITS: 60 HOURS)

1. Extraction of DNA from body fluids.
2. Karyotyping with the help of photographs/teaching kits.
3. To study the karyotyping of chromosomes from the given animal samples
4. Identification of inactivated X chromosomes as barr body from the given sample
5. Methylation specific-PCR to differentiate and detect unmethylated versus methylated cytosines.

BOOKS RECOMMENDED:

1. Principles of Genetics by Gardner, E.J., Simmons, M.J., Snustad, D.P. Wiley India.
2. Principles of Genetics by Snustad, D.P., Simmons, M.J. V Edition. John Wiley and Sons Inc.
3. Concepts of Genetics by Klug, W.S., Cummings, M.R., Spencer, C.A. Benjamin Cummings.
4. Epigenetics by Allis, Jenuwein, and Reinberg. Cold Spring Harbor Press.
5. Epigenetics by Lyle Armstrong. Garland Science.
6. The Epigenetics Revolution: How Modern Biology Is Rewriting Our Understanding of Genetics, Disease, and Inheritance by Nessa Carey. Columbia University Press.

1st SEMESTER
CLINICAL BIOCHEMISTRY: CLINICAL DIAGNOSTICS
SKILL ENHANCEMENT COURSE (SEC)

CBC125S: CLINICAL DIAGNOSTICS-I: FUNDAMENTALS OF CLINICAL DIAGNOSTICS AND LABORATORY SKILLS

CREDITS: THEORY - 2, PRACTICAL - 2

Objectives and Learning Outcome:

At the end of the course, the students shall be able to understand and apply core biochemical principles in clinical laboratory analysis, including safe sample handling and equipment use. Gain foundational knowledge of key biochemical parameters and hematological concepts relevant to diagnostic practice.

Unit I - Basic principles of Clinical Diagnostics (15 hrs)

Introduction to Clinical Biochemistry: Scope and Importance, Types of Samples, Sample Collection, Processing and its phases, Laboratory Safety and Ethics in Clinical Biochemistry, Principles of Biochemical Analysis: Colorimetry, Spectrophotometry, Electrophoresis; Introduction to Automation and Biochemistry Analyzers, Types of Analysers: Semiautomatic and fully Automatic; Point of Care Testing - Basic concept and application; Basics of Quality Control - Introduction to Internal and External QC

Unit II - Hematology (15 hrs)

Introduction to Hematology & Composition of Blood. Blood Collection: Venipuncture, Skin Puncture, Use of Tourniquet; Tube Additives and Labelling-use of Barcode; Erythrocyte Sedimentation Rate (ESR) and its Significance, Complete Blood Count (CBC) including Haematocrit (Packed Cell Volume), Red Cell Indices (MCV, MCH, MCHC)- Reference ranges and diagnostic implications. Overview of Hemostasis and Blood Coagulation. Blood Grouping and Rh System

Practicals (30 hrs)

1. Biochemical Calculations – Percent Solutions, Molarity, Molality, Normality and Preparation of Solutions of different concentrations
2. Blood Specimen Collection Techniques - venipuncture and Skin Puncture
3. Demonstration of Blood Grouping (ABO and Rh Typing)
4. Separation of Serum and Plasma from Blood
5. Coagulation Tests - PT, APTT, TT, INR

Recommended Books:

1. Tietz, N.W. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics. 5th Edition. St. Louis, MO: Elsevier/Saunders.
2. Mukherjee, K.L. Medical Laboratory Technology: A Procedure Manual for Routine Diagnostic Tests, Volume 1. 2nd Edition. New Delhi: Tata McGraw-Hill Education.
3. Kawthalkar, S.M. Essentials of Clinical Pathology. 2nd Ed. New Delhi: The Health Sciences Publisher.
4. Varley, H., Gowenlock, A.H., & Bell, M. Practical Clinical Biochemistry. 10th Edition. New Delhi: CBS Publishers & Distributors Pvt. Ltd.
5. Praful B. Godkar, Darshan P. Godkar Textbook of Medical Laboratory Technology, Clinical Laboratory Science and Molecular Diagnosis. Bhalani Publications.

2nd SEMESTER
CLINICAL BIOCHEMISTRY: CLINICAL DIAGNOSTICS
SKILL ENHANCEMENT COURSE (SEC)

CBC225S: CLINICAL DIAGNOSTICS-II - ORGAN FUNCTION TESTS
CREDITS: THEORY - 2, PRACTICAL – 2

Objectives and Learning Outcome:

At the end of the course, the students shall be able to analyze and interpret biochemical parameters used in liver and kidney function assessments. Perform organ-specific diagnostic tests and correlate findings with clinical scenarios

Unit I. Liver Function Tests (15 hrs)

Structure and Function of the Liver. Liver dysfunction-Jaundice, Hepatitis, Cirrhosis, Fatty Liver Disease. Liver Function Tests: Tests to Evaluate Excretory, Synthetic and Metabolic Functions of Liver, Tests to Evaluate Hepatic Injury (Liver Enzyme Studies). Interpretation of Liver Test Panels: Reference range & Clinical Interpretation

Unit II. Kidney Function Tests (15 hrs)

Structure and Function of the Kidneys-Formation of Urine and Maintenance of Acid-Base Balance. Factors Affecting Renal Function. Kidney Diseases: Renal Calculi, Glomerulonephritis and Chronic Kidney Disease. Renal Function Tests: Urinalysis, Blood Urea Nitrogen (BUN), Serum Creatinine, Tests to Evaluate Glomerular Function, Tests to Evaluate Tubular Function

Practicals (30 hrs)

1. Estimation of Serum SGOT (AST), SGPT (ALT) and ALP
2. Estimation of Serum Bilirubin (Direct and Indirect)
3. Estimation of Blood Urea Nitrogen (BUN) and Serum Creatinine
4. Estimation of Serum Total Protein and Albumin
5. Basic Urine Analysis (Physical, Chemical Tests)

Recommended Books:

1. Kawthalkar, S.M. (2018). Essentials of Clinical Pathology. 2nd Edition. New Delhi: The Health Sciences Publisher.
2. Mukherjee, K.L. (2007). Medical Laboratory Technology: A Procedure Manual for Routine Diagnostic Tests, Volume 1. 2nd Edition. New Delhi: Tata McGraw-Hill Education.
3. Tietz, N.W. (2012). Tietz Textbook of Clinical Chemistry and Molecular Diagnostics. 5th Edition. St. Louis, MO: Elsevier/Saunders.
4. Sonnenwirth, A.C., & Jarrett, L. (2000). Gradwohl's Clinical Laboratory Methods and Diagnosis. 8th Edition. New Delhi: M.D. Publications Pvt. Ltd.
5. Varley, H., Gowenlock, A.H., & Bell, M. Practical Clinical Biochemistry. 10th Edition. New Delhi: CBS Publishers & Distributors Pvt. Ltd.

3rd SEMESTER
CLINICAL BIOCHEMISTRY: CLINICAL DIAGNOSTICS
SKILL ENHANCEMENT COURSE (SEC)

CBC325S: CLINICAL DIAGNOSTICS–III _ LABORATORY AND POINT-OF-CARE TESTING FOR CARDIOMETABOLIC DISORDERS

CREDITS: THEORY - 2, PRACTICAL - 2

OBJECTIVES AND LEARNING OUTCOME:

At the end of the course, the students shall be able to interpret biochemical markers in lipid disorders, cardiac diseases, and diabetes mellitus. Apply point-of-care testing (POCT) for rapid screening and monitoring. Develop skills in advanced diagnostic test interpretation and clinical decision-making.

Unit I- Laboratory and POCT Approaches in Cardiovascular Disorders (15 hrs)

Basic Cardiac Physiology, Lipoproteins: Structure, Function, Classification and their role in cardiac health, Overview of Cardiac Disorders: Atherosclerosis, Heart Failure, Coronary Artery Disease and Myocardial infarction; Diagnosis of Cardiac diseases; Cardiac Markers: types and clinical significance (CK-MB, LDH, Troponins, BNP); POCT in Cardiac Care - Troponin T

Unit II- Laboratory and POCT Approaches in Metabolic disrders (15 hrs)

Overview of Major metabolic disorders: Obesity, Diabetes Mellitus and Metabolic syndrome; Role of Insulin and Glucagon in maintaining glucose homeostasis; Diabetes - Classification, Symptoms, and Risk Factors; Indications for Diabetes Testing; Blood Glucose Tests: FBS, PPBS, RBS, OGTT and gestational diabetes testing; HbA1c and its Significance, Use of POCT Devices - Glucometer, Dipsticks

Practicals (30 hrs)

1. Estimation of Fasting and Postprandial Blood Glucose
2. Oral Glucose Tolerance Test
3. Urine Glucose Analysis
4. Lipid Profile
5. Demonstration of POCT - Glucometer and Trop - T

Recommended Books:

1. Kawthalkar, S.M. (2018). Essentials of Clinical Pathology (2nd ed.). New Delhi: The Health Sciences Publisher.
2. Mukherjee, K.L. (2007). Medical Laboratory Technology: A Procedure Manual for Routine Diagnostic Tests (Vol. 1, 2nd ed.). New Delhi: Tata McGraw-Hill.
3. Tietz, N.W., & Saunders, W.B. (2012). Tietz Textbook of Clinical Chemistry and Molecular Diagnostics (5th ed.). St. Louis, MO: Elsevier/Saunders.
4. Guyton, A.C., & Hall, J.E. (2021). Textbook of Medical Physiology (14th ed.). Philadelphia, PA: Elsevier.
5. Bishop et al Clinical Chemistry: Techniques, Principles, Correlations.