SCHEME & SYLLABUS
M. Sc. Clinical Biochemistry

(Choice Based Credit System)
Program Code: PG031

Department of Life Sciences and Allied Health Sciences
UIS
SANT BABA BHAG SINGH UNIVERSITY
2024

ABOUT THE DEPARTMENT

The department of Life Sciences formerly known as the Department of Natural Sciences was established in the year 2015 with only two UG programmes. Over the years this department has flourished and is offering various programmes and courses at graduate, post-;graduate and doctorate level in the field of Botany, Zoology, Biotechnology, Biochemistry, Microbiology and Laboratory Sciences. The department is nurtured by the highly qualified and dedicated Faculty, honoured by various international and national awards. The department is blessed to have specialized faculties in various fields of Life Sciences viz. Molecular Biology and Biochemistry, Endocrinology, Animal Toxicology, Environmental Toxicology, Biotechnology, Microbial Biotechnology, Animal Biotechnology, Chemical Ecology, Microbial Physiology, Industrial Microbiology, Clinical Microbiology, Entomology, Parasitology, Sericulture, and Biodiversity.

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SALIENT FEATURES OF THE DEPARTMENT

- Research-oriented curriculum designed to enable students to acquire all the skills needed to collect and analyze data.
- The Institute draws upon its strength of highly qualified well well-trained faculty, state-of-the-art infrastructure and innovative teaching methodology.
- Elective courses that bridge the gap between industry requirements and academia.
- The department is disseminating various educational missions via e-learning platform in the form of SWAYAM, Virtual lab etc.
- The department is equipped with many instruments and facilities like UV-Visible Spectrophotometer, High-Speed Centrifuge, Deep Freezer, Semi-automatic Biochemistry analyzer, fully automated Hematology analyzer, Laminar Air flow, Air Samplers, Autoclave, Incubator, Photo actometer, Air condition Labs, WiFi, Library etc.
- The department has organized a large number of conferences, seminars, symposia, and workshops. National and International eminent scientists of the country have been associated with the Department as visiting and honorary professors.

• M. Sc. Clinical Biochemistry

Scientific and technological advancements have created complexity in the diagnostic field necessitating advanced educational preparation. To keep pace with the tremendous progress in Medical Science and to meet changing health care needs specialization and research are essential in the field of Laboratory science. The university specializes in M. Sc. Medical Microbiology, M. Sc. Medical Laboratory Science (Clinical Biochemistry), M. Sc. Medical Laboratory Science (Clinical Microbiology) and M.Sc. Clinical Biochemistry.

VISION

To bridge the gap between demand and supply for life sciences, allied health sciences & agriculture professionals with grooming young generations, empowering them to become socially responsible leaders.

MISSION

To radiate the knowledge of life sciences, allied health science & agriculture sciences through quality education by using the latest technology, modern infrastructure and the framework needed for the development of professionals.

ELIGIBILITY CRITERIA

B.Sc. MLT/MLS/ Applied Medical Science/Bio-Science/ Medical Science/ Allied Medical Science/ Life Science/Microbiology/Biochemistry/ Biotechnology.

DURATION

2 Years

CAREER PATHWAYS

The program is designed to meet the growing requirement of qualified professionals in the field of healthcare industry and education. The Clinical Biochemists/technicians may be assigned to a specialized area of work in a large medical labs/ research labs/ Intermediate reference labs. They can also work as laboratory managers/consultants/supervisors, health care administrators, hospital outreach coordinators, laboratory information system analysts/consultants, educational consultants/coordinators/directors, and health and safety officers.

PROGRAMME EDUCATIONAL OBJECTIVE (PEO)

PEO1. To educate graduates in basic and advanced areas of Clinical Biochemistry and other related subjects along with sensitizing them to the scope for research.

PEO2. To empower the students with analytical and research skills.

PEO3. To foster entrepreneurial endeavors and to prepare a competent generation of clinical biochemists

PEO4. To develop biochemists with skills to pursue careers both in academia as well as in industry.

PROGRAMME OUTCOMES (PO)

PO1. Disciplinary Knowledge: The students will acquire in-depth knowledge of the various theoretical and practical concepts such as the structure and function of biomolecules, their degradation and synthetic pathways, using various analytical techniques, and gain knowledge on complex analyses and characterization of biological samples.

PO2. Critical Thinking: Critical thinking as an attribute will enable students to identify, formulate and apply knowledge to develop critical thinking and practical understanding in the field of clinical biochemistry to find solutions for human benefits.

PO3. Problem Solving: The students will gain hands on experience in state-of-the-art laboratory equipments that will enrich them to perform high through put research in the field of clinical biochemistry. They will be able to process information and ensure quality control as appropriate to routine laboratory

PO4. Scientific /Analytical Reasoning: The students will be able to investigate and perform experiments related to biochemical analysis based on scientific reasoning to draw logical conclusions. They will be able to make specimen oriented decision on predetermined criteria including working knowledge of critical values.

PO5: Modern Tool Usage: Students will gain expertise in the usage of statistical tools for advanced molecular and clinical data analysis.

PO6: Multicultural Competence: Development of a set of competencies in order to enhance and promote the growth of multicultural sensitivity within the university to assess societal, health, safety, legal and cultural issues. Integrating multicultural awareness such as race, gender, physical ability, age, income and other social variables and by creating an environment that is welcoming for all students.

PO6. Environment & Sustainability: Students will understand the impact of scientific solutions in societal and environmental contexts and demonstrate the knowledge and need for sustainable development. And will be able to utilize the gained scientific knowledge to create eco-friendly environment.

PO7. Research Skills & Ethics: The students will develop the skill to think independently, propose and execute research in the field of Clinical Biochemistry. The students will apply ethical principles and professional norms while following scientific practices.

PO8. Individual and Teamwork: The students will acquire the ability to function effectively as teams to accomplish a common goal. The student will be capable of contributing meaningfully to team ethos and goals.

PO9. Communication Skills: Students will be encouraged to communicate scientific concepts, experimental results and analytical arguments clearly and concisely, both verbally and in writing.

PO10. Lifelong Learning: Students will opt for higher studies, jobs in various sectors and entrepreneurship abilities in the field of clinical biochemistry.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO1. Learners will be equipped with a theoretical and practical knowledge of Clinical Biochemistry along with advanced molecular biology study.

PSO2. Learners will be capable of performing or supervising routine Clinical Biochemistry laboratory testing and molecular biology-based diagnostic procedures.

PSO3. Learners will be well equipped in performing experiments related to biochemical investigation of biological samples, Immunology, Molecular Biology, Recombinant DNA Technology and Analytical techniques.

PSO4. Learners will be capable of designing and executing short research projects incorporating techniques of Basic and Advanced Biochemistry under supervision.

PSO5. Learners will be able to take up a suitable position in academia or industry or hospital settings, and to pursue a career in research if so desired.

INDEX

28.	CBH619	Bioinformatics	3	
29.	CBH621	Advanced Molecular Diagnostic Techniques	3	
30.	MMB615	Research Methodology	3	
31.	CBH603	Metabolism of Proteins and Nucleic acids (Practical)	3	
32.	CBH607	General Physiology & Organ Function Test (Practical)	3	
33.	CBH609	Applied Molecular Biology (Practical)	3	
34.	CBH623	Seminar/NPTEL course/ J. Club	3	
35.	CBH602	Dissertation/Project	4	

Course Scheme
M. Sc. Clinical Biochemistry (Semester-I-IV)

SEMESTER I

I. Theory Subjects

S. No	Sub Code	Subject Name	Contact Hours (L: T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours	Course Type
1	CBH501	General Biochemistry	4:0:0	4:0:0	4	4	CC
2	CBH505	Enzymology	4:0:0	4:0:0	4	4	CC
3	CBH509	Fundamentals of Immunology	4:0:0	4:0:0	4	4	CC
4	CBH513	Physical Biochemistry	3:0:0	3:0:0	3	3	CC
5	MMB521	Bioethics, Biosafety & Intellectual Property Right	3:0:0	3:0:0	3	3	SECC
6	EVS003	Natural Hazards & Disaster Management	3:0:0	3:0:0	3	3	AECC

II. Practical Subjects

1	CBH503	General Biochemistry Practical	0:0:4	0:0:2	4	2	CC
2	CBH507	Enzymology Practical	0:0:4	0:0:2	4	2	CC
3	CBH511	Fundamentals of Immunology Practical	0:0:3	0:0:1.5	3	1.5	CC
Total					**32**	**26.5**	

Total Contact hrs: 32
Total Credit Hours: 26.5

SEMESTER II

I. Theory Subjects

S. No	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours	Course Type
1	CBH502	Metabolism of Carbohydrates and Lipids	4:0:0	4:0:0	4	4	CC
2	CBH506	Clinical Biochemistry	4:0:0	4:0:0	4	4	CC
3	CBH510	Fundamentals of Molecular Biology	3:0:0	3:0:0	3	3	CC
4	CBH514	Automation in the clinical Biochemistry Laboratory	2:0:0	2:0:0	2	2	SECC
4	CBH516	Elective I	3:0:0	3:0:0	3	3	DSE
5	CBH518	Elective II					
6	CBH520	Elective III					
7	MAT515	Biostatistics	3:0:0	3:0:0	3	3	ID
8	CSE554	Introductory Concepts of Computer Technology	3:0:0	3:0:0	3	3	AECC

II. Practical Subjects

1	CBH504	Metabolism of Carbohydrates and Lipids Practical	0:0:3	0:0:1.5	3	1.5	CC
2	CBH508	Clinical Biochemistry Practical	0:0:3	0:0:1.5	3	1.5	CC
3	CBH512	Fundamentals of Molecular Biology Practical	0:0:3	0:0:1.5	3	1.5	CC
4	CSE556	Introductory Concepts of Computer Technology Practical	0:0:2	0:0:1	2	1	ID
Total					**32**	**27.5**	

- **Elective I:** Endocrinology
- **Elective II:** Clinical Laboratory Organization and Management
- **Elective III:** Pharmacology Biochemistry

Total Contact hrs: 32
Total Credit Hours: 27.5

SEMESTER III

I. Theory Subjects

S. No	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours	Course Type
1	CBH601	Metabolism of Proteins and Nucleic acids	4:0:0	4:0:0	4	4	CC
2	CBH605	General Physiology & Organ Function Test	4:0:0	4:0:0	4	4	CC
3	CBH607	Applied Molecular Biology	4:0:0	4:0:0	4	4	CC
4	CBH611	Elective I	3:0:0	3:0:0	3	3	DSE
5	CBH613	Elective II					
6	CBH615	Elective III					
7	CBH619	Bio-informatics	2:0:0	2:0:0	2	2	SECC
8	CBH621	Advanced Molecular Diagnostic Techniques					
9	MMB615	Research Methodology	3:0:0	3:0:0	3	3	AECC

II. Practical Subjects

1	CBH603	Metabolism of Proteins and Nucleic acids Practical	0:0:3	0:0:3	3	1.5	CC
2	CBH607	General Physiology & Organ Function Test Practical	0:0:3	0:0:3	3	1.5	CC
3	CBH609	Applied Molecular Biology Practical	0:0:4	0:0:2	4	2	CC
4	CBH623	Seminar/NPTEL course/ J. Club	0:0:2	0:0:1	2	1	AECC
Total					**32**	**26**	

- **Elective I:** Biochemical Toxicology
- **Elective II:** Nutritional Biochemistry
- **Elective III:** Nano-Biochemistry

Total Contact hrs: 32
Total Credit Hours: 26

SEMESTER-IV

Dissertation/Project

S.No	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours	Course Type
1	CBH602	Dissertation/Project	6 Months	0:0:26	512	26	CC

Note: Each student will submit a Project report on any topic related to Clinical Biochemistry. Subject teachers of the University will guide project report and will be examined by an external Examiner.

Contact Hours*: Submission within six months

Total Contact hrs: 512
Total Credit Hours: 26

COURSE SCHEME SUMMARY

Semester		L	T	P	Contact hrs/ wk	Credits
1		21	0	11	32	26.5
2		19	0	13	32	25.5
3		18	0	12	30	24
4		0	0	26	26	26
Total		**58**	**0**	**62**	**120**	**102**

Total Contact hours for I-III semester: 94
Total Credit Hours for I-III semester: 76

Total Contact hours for IV semester: 512 (Five Months)
Total Credit Hours for IV semester: 26

FIRST SEMESTER

GENERAL BIOCHEMISTRY

Course Code	CBH501
Course Title	General Biochemistry
Type of course	CC
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. MLS or B.Sc. (Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	To gain knowledge about the principles governing complex biological systems with special emphasis on structural bases, unique characteristics, biological roles of biomolecules.
Course Outcomes	At the conclusion of the course, the students will: 1. Be able to demonstrate their knowledge and understanding of the molecular machinery of living cells and the interactions between them. 2. Understand the role of water in biological systems. 3. Be acquainted with the knowledge of structure, functions and properties of carbohydrates, lipids, proteins and nucleic acids. 4. Be aware of the significance of vitamins and minerals as essential components of life.

UNIT-I

Understanding of Biochemistry as a discipline and milestone discoveries in life sciences led to the establishment of Biochemistry as a separate discipline.

Fundamental properties of elements, their role in the formation of biomolecules and chemical reactions within living organisms.

Understanding of the concepts of mole, mole fraction, molarity, etc. and applying them in preparations of solutions of desired strengths

The unique property of water as a universal solvent and its importance in biological systems.

UNIT-II

Chemistry of Carbohydrate: Definition, empirical formulae, Classification and Biological Importance.

Monosaccharide: Properties of monosaccharides (oxidation, reduction, reducing property, formation of glycosides, acylation, methylation, condensation – phenyl hydrazine, addition – HCN), Stereochemistry of monosaccharides, (+) and (-), D and L, epimers, anomers, and diastereoisomers, Structure and biological importance of amino sugars, deoxy sugars, sugar acids, neuraminic and muramic acid

Disaccharide: Structures of sucrose and lactose, biological importance and structure of isomaltose, trehalose and maltose.

Polysaccharides: Structure, occurrence and importance of starch, glycogen, inulin, cellulose, chitin, and pectin

Glycosaminoglycans: Occurrence, importance and the structure of the repeating units of heparin, hyaluronic acid, teichoic acid and chondroitin sulphate. Bacterial cell wall

polysaccharide, peptidoglycans
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Chemistry of Lipids: Definition, Classification and biological role of lipids
Fatty acids: Nomenclature of saturated and unsaturated fatty acids. Physiological properties of fatty acids**,** Essential fatty acids
Simple Lipids: Acylglycerols (Mono, di and triglycerols), Saponification, saponification value, iodine value, acid value and significance**.**
Phosphoglycerides: Structure of lecithin, cephalins, phosphatidylinositol, plasmalogens, and cardiolipin. Biological role of phosphoglycerides.
Sphingolipids: Structure and importance of sphingomyelin. Glycosphingolipids: Structure and importance of gangliosides and cerebrosides**.**
Eicosanoids: Structure of PGE2, and PGF2α importance of prostaglandins. Biological roles of thromboxane, leukotrienes and prostaglandins.

UNIT-III
Chemistry of Protein: Structure and classification of amino acids based on polarity. Reactions of the amino groups with HNO2, LiAlH4, ninhydrin, phenyl isothiocyante, dansyl chloride, flurodinitrobenzene. Zwitterionic properties. Pka values. Reaction of carboxyl group – Hydrazine. D & L notation
Peptides: Peptide bond, structure and biological importance of glutathione, valinomycin, leuenkaphelin, synthetic peptides: polyglutamic acid, polylysine. Chemical synthesis of dipeptides.
Proteins: Isolation, methods of purification-dialysis salting out, pH precipitation and solvent precipitation. Classification of proteins based on solubility, structure and functions with examples. Primary Structure of proteins, methods of determining N- and C- terminal amino acids, amino acid composition. Sequencing by Edman's degradation method.
Secondary Structure: α Helix. β-sheet, β-bend, Tertiary structure of myoglobin and quaternary structure of hemoglobin, denaturation and renaturation of proteins.

UNIT-IV
Chemistry of Nucleic acids: Composition of DNA. Nucleosides and nucleotides. Chargaff's rule. Watson and Crick model of DNA. Melting of DNA (Tm).
RNA: Composition, types (mRNA, tRNA and rRNA), secondary structures of tRNA – clover leaf model. Chemical reactions of RNA and DNA with acid and alkali, colour reactions of DNA and RNA.

Vitamins: Sources, RDA, Functions & deficiency manifestation of Fat-soluble vitamins (A, D, E, K), Water soluble vitamins (B complex & Vitamin C)

Minerals: Sources, Functions & deficiency manifestation of Calcium, Phosphorus, Iron, Copper, Zinc, Magnesium, Manganese, Iodine, Sodium, Potassium, Fluoride, Selenium

Text & Reference Books:

S. No	Name/Title	Author	Publisher
1	Lehninger Principles of Biochemistry, 6th Ed.	Lehninger, A., Nelson, & Cox, M.M.	Macmillan Worth Publishers, New Delhi

2	Fundamentals of Biochemistry, 5th Ed.	Voet D., Voet JG and Pratt CW	John Wiley & Sons. New York.
3	Text Book of Medical Biochemistry	Chatterjee, M.M & Shinde, R.	Jaypee Brothers
4	Biochemistry (1995)	L. Stryer	W.H. Freeman Press, San Francisco, USA.
5	Text Book of Biochemistry (2018)	D.M. Vasudevan	
6	Biochemistry	U. Sathyanarayana	Books and Allied (P) Ltd. Kolkata

Enzymology

Course Code	CBH505
Course Title	Enzymology
Type of course	CC
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. MLS or B.Sc. (Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	This course aims to comprehend the importance of enzymes as biological catalysts, the regulation of enzyme function and the variety of applications enzymes have in research in the biological sciences, health and industry.
Course Outcomes	After the course, the students will: 1. Understand the basic principles of enzyme function and enzyme catalysis and the factors affecting their efficiency. 2. Able to explain the mechanisms of enzyme reactions and catalytic strategies, principles of enzyme kinetics, and their importance in fundamental biochemical reactions of cells and organisms 3. Know the principles of development and study of compounds for enzyme activation and inhibition and the mechanism of enzyme regulation and its importance in regulating the vital processes of organisms. 4. Possess the knowledge of current applications and prospects in the field of Enzymology

Unit I

Introduction to Enzymes: Nomenclature, Classification and Characteristics of enzymes, Enzyme specificity, Cofactors, Co-enzyme and Prosthetic group.

Mechanism of Enzyme Action: Nature of active site, identification of functional groups at active site, enzyme-substrate complex, Lock and key and Induced fit hypothesis.

Catalytic efficiency of enzymes: Enzyme unit and Catalysis, Factors affecting catalytic efficiency of enzymes; Proximity and orientation, covalent catalysis, Acid-base catalysis, Strain and distortion theory

Unit II

Mechanism of action of selected enzymes: Chymotrypsin, Lysozyme, Carbonic anhydrase, Ribonuclease, Involvement of co-enzymes in enzyme-catalyzed reactions, RNA molecules as enzymes.

Enzyme Kinetics: A brief concept of bioenergetics and kinetics, Kinetics of single and bi-substrate enzyme-catalyzed reactions, Michaelis-Menten equation, Derivation of Michaelis-Menten equation and determination of Km and Vmax values, significance of Km values.

Unit III

Enzyme Inhibition: Reversible and irreversible inhibition, Kinetics of competitive, uncompetitive and non-competitive inhibition, Random, Ordered, Theorell & Chance, and

Ping-pong mechanism, Substrate inhibition and activation, Effect of pH and temperature on rate of enzyme catalyzed reactions.

Regulation of Enzyme Activity: Allosteric enzymes and control of metabolic pathways, Mechanism of Aspartate transcarbamoylase, Sigmoidal behavior, sequential and concerted models, Reversible covalent modification and zymogen activation, Isozymes and their importance, Proteolytic activation

Unit IV

Enzyme Technology: Extraction and purification of enzymes, Enzymes as analytical reagents, Immobilized enzymes, Biotechnological applications of enzymes, Application of enzymes in medicine and industry.

Clinical Significance of Enzymes: Types of Plasma Enzymes: Functional and non-functional; their sources and medical importance. Diagnostic precision of plasma enzyme analysis, Factors affecting results of plasma enzyme assays, Diagnostic enzymes in different diseases: Liver, Myocardial Infarction, Muscle and Bone diseases, Cancer and GI tract diseases.

Text & Reference Books:

S. No	Name/Title	Author	Publisher
1	Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, 2nd Ed.	Palmer, T. and Bonner, P L	East West Press, India
2	Lehninger Principles of Biochemistry, 6th Ed.	Lehninger, A., Nelson, & Cox, M.M.	Macmillan Worth Publishers, New Delhi
3	Fundamentals of Biochemistry, 5th Ed.	Voet D., Voet JG and Pratt CW	John Wiley & Sons. New York.
4	Text Book of Medical Biochemistry	Chatterjee, M.M & Shinde, R.	Jaypee Brothers
5	Biochemistry (1995)	L. Stryer	W.H. Freeman Press, San Francisco, USA.

Fundamentals of Immunology

Course Code	CBH509
Course Title	Fundamentals of Immunology
Type of course	CC
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	The course aims to impart knowledge on the basics of immunology including structural components, their functions and underlying mechanisms.
Course Outcomes	At the conclusion of the students will: 1. Learn the fundamental principles including cellular and molecular components of immune response 2. Understand the structure and functions of antigens, different classes of immunoglobulins, and their importance in combating pathogens. 3. The student will learn and understand the rationale behind various assays used in the immune-diagnosis of diseases and will be able to transfer knowledge of immunology in a clinical perspective. 4. Able to explain the principles of Graft rejection, Autoimmunity and role of immunity in protection against pathogens.

UNIT-I

Immunity: Historical perspectives, Cellular and humoral immunity, Immune response: mechanism of innate and adaptive immune response, Mediators and process of inflammation

Structure and Function of Immune System: primary and secondary lymphoid organs (bone marrow, thymus and spleen), Structure and function of cells involved in immune response: T and B lymphocytes, Helper and Killer T-cells, Macrophages, antigen presenting cells.

Complement activation by Classical, alternate and MB lectin pathway, Biological consequences of complement activation, Regulation and complement deficiencies.

UNIT-II

Antigens: structure and properties, factors affecting the immunogenicity, haptens, superantigen, adjuvants

Antibody: Definition, types and structure of immunoglobulins (IgG – light chain, heavy chain, hypervariable region, constant domains, Fab and Fc). Effector functions of antibody, antigenic determinants on Ig, Ig superfamily. Monoclonal antibodies production and applications

Antigen-Antibody interaction: Formation of antigen-antibody complex. Application of immunodiffusion, RIA, ELISA (Basic principles only)

UNIT-III

Major histocompatibility complex: Polymorphism of MHC genes, role of MHC antigens in immune responses, MHC antigens in transplantation

Cytokines: Types, structure and functions, cytokines receptors, cytokine regulation of immunoreceptors.

Immunization: Active and passive immunization, Types of vaccine: whole organism vaccine, sub unit vaccine, DNA vaccine, recombinant vaccine, subunit vaccines and anti-idio type vaccine.

UNIT-IV

Immunological disorders: Allergy and AIDS. Structure of HIV, mode of transmission**.** Immunodeficiency diseases: primary and secondary immunodeficiency.

Autoimmunity: Self-tolerance and possible mechanisms of induction of autoimmunity, Organ-specific and systemic autoimmune diseases

Hypersensitivity: Type I, II, III and type IV hypersensitivity.

Transplantation immunology: Immunologic basis of graft rejection, clinical manifestation of graft rejection and clinical transplantation.

Text & Reference Book:

S. No	Name	Author(S)	Publisher
1	Immunology, 5th Edition	Janis Kuby	W.H.Freeman & Co Ltd
2.	Essential Immunology, 9th Edn.	Ivan M. Roitt	Blackwell Science, Inc.
3.	Handbook of Human Immunology	Mary S. Leffell & Noel R. Rose,	CRC press
4.	Fundamentals of Immunology	Paul, W.	L. Williams & Wilkins
5.	Janeway's Immunobiology	Charles Janeway	6th Edition Garland Science

Physical Biochemistry

Course Code	MMB519
Course Title	Physical Biochemistry
Type of course	CC
L T P	3 0 0
Credits	3
Course prerequisite	B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	To give students knowledge about the different Instruments used in biological sciences and prepare them for research work.
Course Outcomes	At the conclusion of the course, the students will: 1. Learn the principles, components and applications of various spectrophotometers used in medical laboratories. 2. Be able to explain the principles, types and applications of chromatographic techniques requisite for biochemical analysis. 3. Understand the working principle of separation techniques in biology like centrifugation and electrophoresis. 4. Gain theoretical knowledge about the radioisotopes used in medical diagnosis, their measurements, dosage and safety guidelines

UNIT- I

Principles and applications of photometry: Absorption of light, Transmittance, Absorbance (Optical density), Lambert-beer law, Method of determining Absorption spectrum of copper sulphate by spectrophotometer, Colorimeter & spectrophotometer; Flame photometer; Atomic absorption spectrophotometer, Nephelometry and turbidimetry and its applications

UNIT-II

Chromatography: General Principles of Adsorption and Partition Chromatography, Types (ascending, descending and 2D) and applications of Paper chromatography, Rf Value, column chromatography and HPLC, Gas Chromatography, Principles of Gel filtration, Ion exchange and Affinity chromatography, Thin layer Chromatography: principle, procedure and applications.

UNIT-III

Separation Techniques: Basic principle of sedimentation, Relative centrifugal force (RCF), Sedimentation rate, sedimentation coefficient, Principle of differential centrifugation, Types of Rotors, Ultracentrifuge – construction and applications in subcellular fractionation

Electrophoresis: Principle, Types & Applications- PAGE and Agarose Gel Electrophoresis, 2D electrophoresis and IEF.

UNIT-IV

Radioisotopes in biology:

Natural and artificial radioactivity, characteristics of radioactive elements, units of radioactivity, disintegration constant, half-life, α, β and γ radiation. Detection of radioactivity by GM and Scintillation counters, Autoradiography

Applications of radioisotopes – ^{3}H, ^{14}C, ^{131}I, ^{60}Co and ^{32}P. Biological effects of radiations. Safety measures in handling radioisotopes, Different types of radioisotopes used in diagnosis.

Text & Reference Books:

S. No.	Name/Title	Author	Publisher
1	Practical Biochemistry	Wilson and Walker	Cambridge
2	Modern Experimental Biochemistry	Boyer	Benjamin
3	Biophysical Chemistry, Principles & Techniques	Upadhyay, Upadhyay and Nath	Himalaya Publ. House
4	Introduction to Instrumental Analysis	Robert Braun	McGraw Hill Int.
5	Experimental Biochemistry	Clark & Switzer	Freeman Publ.
6	Bio-instrumentation	Veerakumari (2011)	MJP Publishers
7	Instrumental Methods of Analysis	Wliard, Merritt, Dean, Settle	Tata McGraw Hill Publishing Co. Ltd., New Delhi
8	Physical Biochemistry: Principles and Applications	Sheehan, D. (2000)	John Wiley and Sons Ltd., Chichester, England.

Bioethics, Bio-safety & Intellectual Property Right

Course Code	MMB521
Course Title	Bioethics, Bio-safety & Intellectual Property Right
Type of course	SECC
L T P	3 0 0
Credits	3
Course prerequisite	M. Sc. Medical Microbiology as Skill Enhancement Course
Course Objective	To inculcate the knowledge of intellectual property right to students and also aware them about Patents, trademark, copyright etc.
Course Outcomes	At the conclusion of the course the students will: 1. Understand the ethical principles & practices and national & international biosafety guidelines. 2. Understand the concept, scope and importance of IPR. 3. Know about patents, copyrights, trademarks and industrial designs. 4. Get awareness of acquiring the patent and copyright for the innovative works.

UNIT I

Ethics: Benefits of Ethics, ELSI of Bioscience, recombinant therapeutic products for human health care, genetic modifications and food consumption, release of genetically engineered organisms, applications of human genetic rDNA research, human embryonic stem cell research.

Biosafety regulation of products microbial products and bioseptic concerns individual society National and international biosafety regulations in Laboratories handling of Recombinant products.

UNIT II

Introduction to intellectual property rights (IPR): Concept and kinds. Economic importance. IPR in India and world: Genesis and scope, some important examples. IPR and WTO (TRIPS, WIPO).

Patents: Objectives, Rights, Patent Act 1970 and its amendments. Procedure of obtaining patents, Working of patents. Infringement.

Copyrights: Introduction, Works protected under copyright law, Rights, Transfer of Copyright, Infringement.

UNIT III

Trademarks: Objectives, Types, Rights, Protection of goodwill, Infringement, Passing off, Defences, Domain name.

Industrial Designs: Objectives, Rights, Assignments, Infringements, Defences of Design Infringement

UNIT IV

Biotechnology and Intellectual Property Rights: Patenting Biotech Inventions: Objective, Applications, Concept of Novelty, Concept of inventive step, Microorganisms, Moral Issues in Patenting Biotechnological inventions. Bio-safety and its implementation,

Text & Reference Books:

S. No.	Name/Title	Author	Publisher
1	Textbook on intellectual property rights	N.K. Acharya	Asia Law House (2001).
2	Understanding Trips: Managing Knowledge in Developing Countries	Manjula Guru & M.B. Rao	Sage Publications (2003).
3	Intellectual Property Rights: Unleashing the Knowledge Economy	P. Ganguli	Tata McGraw-Hill (2001).
4	Intellectual Property: Patents, Trademarks and Copyright in a Nutshell	Arthur Raphael Miller, Micheal H. Davis	West Group Publishers (2000).
5	Intellectual property rights in the WTO and developing countries	Jayashree Watal	Oxford University Press, Oxford

Natural Hazards and Disaster Management

Course Code	EVS003
Course Title	Natural Hazards and Disaster Management
Type of course	AECC
L T P	3 0 0
Credits	3
Course prerequisite	Graduation
Course Objective	To learn about natural hazards, risk assessment and disaster management
Course Outcomes	At the conclusion of the course the students will: 1. Learn the concept of natural hazards 2. Understand the role of Disaster management system

UNIT I

Overview of natural hazards: Introduction to natural hazards, impact and mitigation in Global and Indian context; causes and consequences of geological hazards, flood, drought and climate change issues, forest hazard, tsunami and coastal hazards, cyclone hazards, snow avalanche, GLOF and glacier related hazards, extreme weather events, urban and industrial hazards.

UNIT II

Introduction to vulnerability and risk assessment, socio-economic and physical aspects of vulnerability and elements of risk mapping, assessment, and reduction strategies.

UNIT III

Earth observation: Data availability and key operational issues for DM: EO systems for natural hazards study: present (operational) and future systems; multi-temporal data sources, multi-temporal database organization: Key operational issues, utilization of geo-information products for disaster management (available through International cooperation e.g. International Charter etc.)

UNIT IV

Disaster management framework of India and recent initiatives by Govt. of India with special emphasis on DRR HFA 2005-2015, MDG and SAARC comprehensive framework for DRR Disaster Management Support (DMS): Status in India for use of space inputs Mainstreaming DRR in Development Planning Sustainable development in the context of Climate Change Disaster Recovery-Strategy and case examples.

Text & Reference Books:

S.No.	Name/Title	Author	Publisher
1	Environmental Hazards: Assessing Risk and Reducing Disaster	Keith Smith and Petley David, 2008.	Routledge
2	Geo-information for Disaster Management	van Oosterom Peter, Zlatanova Siyka and Fendel Elfriede, 2005	Springer-Verlag
3	Geospatial Techniques in Urban Hazards and Disaster Analysis	Showalter, Pamela S. and Lu, Yongmei, 2010.	John Wiley and Sons.

4	An International Perspective on Natural Disaster: Occurrence, Mitigation and Consequences	Stoltman JP, Lidstone J and Dechano LM., 2004.	Kluwer Academic Publishers

GENERAL BIOCHEMISTRY PRACTICAL

Course Code	CBH503
Course Title	General Biochemistry Practical
Type of course	CC
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. MLS or B.Sc. (Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	The course aims to enable the students to 1. Develop basic practical skills for handling and analysis of biomolecules. 2. Provide hands-on-practice about various qualitative and quantitative test procedures for the detection of carbohydrates, proteins, lipids and nucleic acids.
Course Outcomes	At the conclusion of the course, the students will: 1. Able to identify and perform various biochemical tests for detection of carbohydrates, lipids and proteins for complex biochemical analysis. 2. Able to demonstrate the preparation of buffers used in clinical laboratories. Be acquainted with the knowledge of structure, functions and properties of carbohydrates, lipids, proteins and nucleic acids. 4. Be aware of the significance of vitamins and minerals as essential components of life.

List of Experiments

1. To detect the presence of carbohydrate in the given sample by Molish test, Fehling's test, Benedict's test, and Barfoed's reagent.
2. To detect the presence of pentose sugar in the given sample by Bial's test and ketose sugar by Seliwanoff’s reagent
3. To detect the presence of starch in given sample by using iodine solution
4. Qualitative tests of proteins and lipids.
5. Preparation of Buffers commonly used in a biochemistry laboratory
6. To demonstrate the principle of spectrophotometry and verification of Beer's law.
7. To determine the carbohydrates by the anthrone method
8. To determine the proteins in the given sample by the Biuret method.
9. Quantification of protein contents in the given sample by Folin'-Lowry method
10. To determine the Saponification value of the given fat sample.

Text and Reference Books:

S. No.	Author(s)	Title	Publisher
1	Pummer, D	An Introduction to Practical Biochemistry	
2.	Harold Varley	Practical Clinical Biochemistry	CBS Publishers & Distributers
3	Frances Fischbach	A Manual of Laboratory & Diagnostic Tests (6th edition)	Lippincott Williams & wilkins
4			

ENZYMOLOGY PRACTICAL

Course Code	CBH507
Course Title	Enzymology Practical
Type of course	CC
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. MLS or B.Sc. (Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	The course aims to enable the students to 3. Impart basic practical skills to work with enzymes 4. Provide hands-on practice about various qualitative and quantitative test procedures for the detection of carbohydrates, proteins, lipids and nucleic acids.
Course Outcomes	At the conclusion of the course, the students will: Be trained to work with enzymes and measuring the estimation of enzyme activity, determination of pH optimum, Km and Vmax of enzymes and analysis of enzyme kinetics.

List of Experiments

1. To determine salivary amylase activity by DNS method
2. To determine acid phosphatase activity
3. Demonstration of time course of salivary amylase/acid phosphatase
4. Determination of Km and Vmax of salivary amylase
5. Determination of initial velocity [time kinetics] of salivary amylase
6. To study the Influence of substrate concentration on the rate of enzymatic reaction
7. To study the Influence of pH on the rate of enzymatic reaction
8. To study the Influence of temperature on the rate of enzymatic reaction

Text and Reference Books:

S. No.	Author(s)	Title	Publisher
1	Pummer, D.T	An Introduction to Practical Biochemistry	Mc Graw Hill, London,
2.	Harold Varley	Practical Clinical Biochemistry	CBS Publishers & Distributers
3	Frances Fischbach	A Manual of Laboratory & Diagnostic Tests (6th edition)	Lippincott Williams & wilkins

FUNDAMENTALS OF IMMUNOLOGY PRACTICAL

Course Code	CBC511
Course Title	Fundamentals of Immunology Practical
Type of course	CC
L T P	0 0 3
Credits	1.5
Course prerequisite	B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Bio-sciences/ Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	This course aims to enable the students to: Develop insight into pathogenicity, diagnosis and prophylaxis of viral infections.
Course Outcomes	At the conclusion of the course, the students will: 1. Able to understand the basic laboratory practices in the field of immunology and learn the technique of serum & plasma separation. 2. Able to determine the TLC, DLC, ABO & Rh factor from blood sample 3. Demonstration of antigen/antibody determination by various immunological techniques. 4. Be able to perform various types of serological tests to diagnose bacterial infection.

LIST OF PRACTICALS

1. Collection, separation and preservation of serum and plasma from blood.
2. To determine Blood group and Rh factor by slide agglutination test
3. To determine Total Leukocyte Count (TLC) for given blood sample
4. To determine Differential Leukocyte Count (DLC) for given blood sample using Leishman stain
5. To precipitate immunoglobulins by ammonium sulphate.
6. To determine total immunoglobulin contents.
7. To perform Ouchterlony double diffusion test for detection of anti.gen and antibody reaction and to demonstrate relationship between antigens.
8. To perform Radial immuno-diffusion test for detection of antigen and antibody reaction and for quantification of antigens.
9. Demonstration of antigen / antibody determination by Immunoflourescence, CCIEP, ELISA.
10. Performance of Serological tests:
    - Widal (Slide and rapid IgG/ IgM)
    - VDRL
    - ASO (Anti-Streptolysin _O)
    - C-Reactive Protein
    - Rheumatoid factor (RF)

Text & Reference Books:

S. No.	Author(s)	Title	Publisher
1	Frank C. Hay Olwyn M.R. Westwood	Practical Immunology, 4th Ed.	Wiley-Blackwell Science
2.	Frances Fischbach	A Manual of Laboratory & Diagnostic Tests	Lippin Cott Wiliam & Wilkins

SECOND SEMESTER

Metabolism of Carbohydrates and Lipids

Course Code	CBH502
Course Title	Metabolism of Carbohydrates and Lipids
Type of course	CC
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Bio-sciences/ Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	This course aims to provide an understanding of the metabolism of carbohydrates and lipids, the enzymes involved in various metabolic pathways and the regulation of these metabolic pathways in cells. The course also aims to outline the importance of such pathways in relation to the metabolic defects.
Course Outcomes	At the conclusion of the course, the students will: 1. Able to understand the concept of metabolism, characteristics of metabolic pathways and different forms of energy currency such as ATP, NADP and FADP in living beings. 2. Gain a detailed knowledge of carbohydrates and lipids' various catabolic and anabolic pathways. 3. Understand the regulation of various pathways. 4. Gain knowledge about the diseases caused by defects in metabolism, emphasizing metabolic control.

UNIT I

Introduction to Metabolism: General concept of metabolism, characteristics of metabolic pathway, Types of Metabolic Pathways, Types of biological oxidation-reduction reactions, Universal electron carriers, Basic principles of metabolic regulation.

Basic principles of B**ioenergetics**: Concepts of free energy, enthalpy and entropy, ATP as energy-rich compound, chemical basis of large free energy of hydrolysis of some energetic compounds, coupled reactions, group transfer, biological energy transducers.

UNIT II

Carbohydrate Catabolism: Digestion and absorption of carbohydrates, glycolysis, fates of pyruvates, citric acid cycle (TCA cycle), Energy yield in glycolysis and TCA, Anaplerotic reactions of TCA cycle, pentose phosphate pathway, Degradation of di and polysaccharides.

Carbohydrate Anabolism: Gluconeogenesis, Role of nucleotide diphosphate sugars, Biosynthesis of disaccharides and polysaccharides,

Regulation of carbohydrate metabolism: Hormonal control of key enzymes in carbohydrate pathways

UNIT III

Electron Transport Chain: Organization of the electron transport chain**,** electron transfer and redox reactions**,** Oxidative Phosphorylation, F1F0 ATPase - Structure and mechanism of action, Inhibitors of the respiratory chain, and Uncouplers and ionophores of oxidative

phosphorylation, Regulation of oxidative phosphorylation, Mitochondrial transport systems - ATP/ADP exchange, malate/glycerophosphate shuttle, creatine - phosphate shuttle.

Metabolic disorders of carbohydrate metabolism

UNIT IV

Lipid Catabolism: Digestion and absorption of lipids, Mobilization of stored lipids, transport of lipoproteins, Oxidation of fatty acids, Energy yield Degradation of triacylglycerols, phosphoglycerides. Sphingolipids, Regulation of lipid Metabolism.

Lipid Anabolism: Fatty acid synthase complex, synthesis of fatty acids, triacylglycerols, phosphoglycerides, sphingolipids, cholesterol metabolism, formation of ketone bodies and their significance.

Integration of carbohydrate and lipid metabolism, Metabolic disorders of lipids.

Text & Reference Books:

S. No	Name/Title	Author	Publisher
1	Lehninger Principles of Biochemistry, 6th Ed.	Lehninger, A., Nelson, & Cox, M.M.	Macmillan Worth Publishers, New Delhi
2	Fundamentals of Biochemistry, 5th Ed.	Voet D., Voet JG and Pratt CW	John Wiley & Sons. New York.
3	Text Book of Medical Biochemistry	Chatterjee, M.M & Shinde, R.	Jaypee Brothers
4	Biochemistry (1995)	L. Stryer	W.H. Freeman Press, San Francisco, USA.
5	Text Book of Biochemistry (2018)	D.M. Vasudevan	
6	Biochemistry	U. Sathyanarayana	Books and Allied (P) Ltd. Kolkata
7.	HARPER'S BIOCHEMISTRY, 22nd edn. (1990),	R.K.Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell,	Prentice-Hall, International, USA.

Clinical Biochemistry

Course Code	CBH506
Course Title	Clinical Biochemistry
Type of course	CC
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Bio-sciences/ Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	This course aims to enable the students to: Develop insight into pathogenicity, diagnosis and prophylaxis of viral infections.
Course Outcomes	At the conclusion of the course, the students will: 1. Able to understand the safety measures in clinical biochemistry, Quality control and quality assurance 2. Correlate biochemical estimations with diagnostic and therapeutic approaches in endocrinology and nutrition. 3. Understand the principles, procedures, and clinical relevance of various immunological techniques (e.g., RIA, ELISA, immunofixation, immunochemistry, turbidimetry, and immunohistochemistry) and tumor marker analysis.

UNIT I

Introduction to clinical laboratory: Laboratory organization, management and maintenance of records., Hazards and safety measures in clinical laboratory, Quality control and Quality assurance.

Principle, procedure, normal ranges and clinical significance of biochemical Investigations of blood serum /plasma, glucose, total proteins and albumins, A/G ratio, estimation of urea, uric acid, creatinine, total cholesterol and bilirubin.

UNIT II

Estimation of Hormones: Principle, procedures, normal ranges and clinical significance of androgen, pregnanediol, estrogens, corticosteroids, catecholamine, thyroid, prolactin, growth hormones: FSH, LH, testosterone;
Vitamins estimations: Vitamin A, thiamin, niacin, pyridoxine, ascorbic acid, vitamin D3

UNIT III

Immunological Techniques: RIA, ELISA, immunofixation, immunochemistry, turbidimetry and immunohistochemistry; Tumor markers

Others- Methods of estimation, principles of assay, normal range in tissues and clinical conditions leading to abnormal levels of Barbiturates, Urobilinogen, Opiates, organophosphorus

Enzymes: Methods of estimation, principles of assay, normal range in tissues and clinical conditions leading to abnormal levels of: SGOT, SGPT, Alkaline phosphatase, Acid phosphatase, Amylase, CPK.

Unit IV

Mineral estimation:
Mineral estimation, principles of assay, normal range in tissues and clinical conditions leading to abnormal levels of: Na, K, Ca, CI, P, lodine, Nitrogen, Zn, Mg, Li.

Renal Function tests: estimation of Na, K, Ca, Cl, O2, CO2, P, Zn, Mg.

Text & Reference Books:

S. No	Name/Title	Author	Publisher
1	Lehninger Principles of Biochemistry, 6th Ed.	Lehninger, A., Nelson, & Cox, M.M.	Macmillan Worth Publishers, New Delhi
2	Fundamentals of Biochemistry, 5th Ed.	Voet D., Voet JG and Pratt CW	John Wiley & Sons. New York.
3	Text Book of Medical Biochemistry	Chatterjee, M.M & Shinde, R.	Jaypee Brothers
4	Medical Laboratory Practices	J.Ochei and Kolathkar	Jaypee publisher
5	Harold Varley	Practical Clinical Biochemistry	CBS Publishers & Distributers

Fundamentals of Molecular Biology

Course Code	CBH510
Course Title	Fundamentals of Molecular Biology
Type of course	CC
L T P	3 0 0
Credits	3
Course prerequisite	B.Sc. MLS or B.Sc. (Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	To provide students with insights to the basics of Molecular Biology
Course Outcomes	1. **Insight into Genome Organization**: Students will understand the structure and regulation of genetic material in prokaryotes and eukaryotes, including chromosomes, introns, exons, and the nuclear matrix. 2. **Proficiency in Molecular Mechanisms**: Students will gain knowledge of DNA replication, repair, recombination, and gene expression regulation, focusing on enzymes and proteins involved. 3. **Application of Molecular Biology Techniques**: Students will be able to apply molecular biology methods to analyze DNA, RNA, and protein structures and functions in research and problem-solving. 4. **Transcriptional and Translational Regulation**: Students will learn the mechanisms of transcriptional and translational regulation in both prokaryotes and eukaryotes. 5. **Comprehensive Understanding of Genetic Information Flow**: Students will understand the process of genetic information flow from DNA to RNA to protein, including replication, transcription, and translation.

UNIT-I

Genome organization: Introduction of genome, Introns and exons, Organization of genetic material in prokaryotes and eukaryotes. Structure of eukaryotic chromosomes; Role of nuclear matrix in chromosome organization and function; Matrix binding proteins; Heterochromatin and Euchromatin.

UNIT-II

DNA Structure; Replication; Repair & Recombination: Structure of DNA - A-,B-, Z- and triplex DNA; DNA Replication, initiation, elongation and termination in prokaryotes and eukaryotes; Enzymes and accessory proteins; Fidelity; Replication of single stranded circular DNA; Gene stability and DNA repair- enzymes; Photoreactivation; Nucleotide excision repair; Mismatch correction; SOS repair; Recombination: Homologous and non-homologous.

UNIT-III

Prokaryotic & Eukaryotic Transcription: Prokaryotic Transcription; Transcription unit; Promoters- Constitutive and Inducible; Operators; Regulatory elements; Initiation; Attenuation; Termination-Rho-dependent and independent; Anti-termination; Transcriptional regulation-Positive and negative; Operon concept-lac, trp, his, and gal operons; Transcript processing; Processing of tRNA and rRNA**,** Eukaryotic transcription and regulation; RNA polymerase structure and assembly; RNA polymerase I, II, III; Eukaryotic promoters and enhancers; General Transcription factors; TATA binding proteins (TBP) and TBP associated factors (TAF); Activators and repressors; Transcriptional and post-transcriptional gene silencing.

UNIT-IV

Prokaryotic & Eukaryotic Translation & Transport: Translation machinery; Ribosomes; Composition and assembly; Universal genetic code; Degeneracy of codons; Termination codons; Isoaccepting tRNA; Wobble hypothesis; Mechanism of initiation, elongation and termination; post-translational modifications; Transport of proteins and molecular chaperones; Protein stability and degradation.

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Text & Reference Books:

S. No	Name/Title	Author	Publisher
1	Gene IX, 9th Edition	Benjamin Lewin	Jones and Barlett Publishers, 2007.
2	Molecular Biology of the Gene, 6th Edition,	J.D. Watson, N.H. Hopkins, J.W Roberts, J. A. Seitz & A.M. Weiner.	Benjamin Cummings Publishing Company Inc, 2007.
3	Molecular Biology of the Cell, 4th edition, Garland, 2002.	Alberts B, Johnson A, Lewis J, et al.	Taylor & Francis Group.
4.	Lubert Stryer, Jeremy Berg & John L tymoczko	Biochemistry	WH Freeman & Co.

Automation in Clinical Biochemistry Laboratory

Course Code	CBH514
Course Title	**Automation in Clinical Biochemistry Laboratory**
Type of course	SECC
L T P	2 0 0
Credits	2
Course prerequisite	B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Bio-sciences/ Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	This course aims to enable the students to: Develop insight into practical aspects of automation in clinical biochemistry.
Course Outcomes	At the conclusion of the course, the students will: 1. Able to understand the basic laboratory practices and assess the impact of automation on laboratory workflow and patient care. 2. Critically evaluate new technologies and trends in laboratory automation. 3. Communicate effectively about automation concepts and technologies to colleagues and other healthcare professional.

Unit I: Introduction to Automation in Clinical Biochemistry Laboratory

Principles of Automation: Definition and types of automation (discrete analyzers, continuous flow, random access)
Benefits of Automation: Increased throughput, improved accuracy and precision, reduced labor costs, enhanced safety.
Components of Automated systems: Sample handling (loaders, sorters, conveyors), Analytical modules (spectrophotometry, fluorometry, chemiluminescence, immunoassay), Data handling and reporting (LIMS integration)

Unit II: Automated Analytical Techniques

Spectrophotometry: Automated spectrophotometers, kinetic assays, endpoint assays.
Electrophoresis: Automated capillary electrophoresis, gel electrophoresis systems.
Chromatography: Automated HPLC, GC-MS systems.
Immunoassays: Automated ELISA systems, chemiluminescence immunoassays

Unit III: Point of care testing (POCT) automation:

Principles of POCT: Advantages and limitations of POCT.
Automated POCT devices: Blood gas analyzers, glucose meters, rapid diagnostic tests, Quality control and data management in POCT

Unit IV: Laboratory Information Management System (LIMS)

Functions of LIMS: Sample tracking, result reporting, data management, and quality control.
Integration of LIMS with automated system: Data exchange, worklist management, instrument control
Benefits of LIMS in clinical laboratory: Improved efficiency, reduced errors, enhanced data

integrity.

Text & Reference Books:

S. No	Name/Title	Author	Publisher
1	Tietz Textbook of clinical chemistry and Molecular diagnostics	Carl A. Burtis, Edward R. Ashwood, David E.Bruns	Elsevier
2	Bishop, Fienberg, and Wittwer's clinical chemistry: principles, Techniques and correlations	Michael L. Bishop, steven E.Fienberg, paul C. wittwer	Lippincott Williams & wilkins
3	Medical Laboratory Practices	J.Ochei and Kolathkar	Jaypee publisher
4.	Text book of Medical Laboratory Technology, Volume 1	Paraful B. Godkar, Darshan P. Godkar	Bhalani Publisher
5	Medical laboratory Technology Volume-I	KL Mukherjee	Tata Mcgraw Hill
6	Hand book of Medical Laboratory Technology (2nd edition)	V.H. Talib	CBS Publishers & Distributors

Endocrinology

Course Code	**CBH516**
Course Title	Endocrinology
Type of course	Theory
L T P	3 0 0
Credits	3
Course prerequisite	B.Sc. Non-Medical or B. Sc. Medical with Zoology as main subject
Course Objective	The course is designed to offer the students a broad understanding of Endocrinology as an important branch of Animal Physiology.
Course Outcomes	The students will able to: 1. Study the classification, modes and phylogeny of endocrine system 2. Study the endocrine control of various physiological mechanisms 3. Study the comparative morphology, anatomy, functions of various endocrine glands present in a human body. 4. Also study the deficiency diseases caused, and chemical structure of hormones secreted from the glands

Unit I

Concept of endocrinology: introduction to the endocrine system, Classification of hormones, modes of hormone secretion. Evolution of pituitary gland. Physiological actions of pituitary hormones Endocrine glands and hormones. Brief account of structural features of endocrine glands, Hormonal effects, and regulation –basic concepts. Factors influencing secretion. Endocrine disorders- brief description

Unit II

Synthesis of thyroid and parathyroid hormone and their physiological actions, calcitonin and of vitamin D3; hormonal regulation of calcium and phosphate homeostasis. Biosynthesis and secretion of pancreatic hormones. Biosynthesis, its storage and release mechanism, Anatomy and physiology of Adrenal gland, Renin-angiotensin system, hormonal control of water and electrolyte balance; Catecholamine, physiological actions of adrenal medullary hormones; Importance of adrenocortical and adrenomedullary interaction

Unit III

Gonadal differentiation, Sexual differentiation: Genetic sex- gonadal sex- somatic sex. Differentiation of testis and Ovary: Morphological, biochemical and hormonal aspects. Development abnormalities of male and female sex organs: genetic and endocrine aspects. Steroidogenesis and its regulation Steroid. Biosynthesis and secretion of gonadal hormones (ovary, testis). Hypothalamo- hypophyseal- gonadal axis

Unit IV

Female reproductive tract- Study of ovary, Ovary: Structure, folliculogenesis, Ovulation. Sources of ovarian hormones, Ovarian androgen, inhibin, Endocrine regulation of ovarine functions. Study of Uterus: Uterus and fallopian tube- Structure, function and hormonal regulation, reproductive cycles in vertebrates. Mammary gland- Structure, function and regulation. Male reproductive tract- Study of male reproductive system: Spermatogenesis and

its regulation. Endocrine regulation of testicular functions

Text

S.No.	Name/Title	Author	Publisher
1	Gardner: Basic and clinical endocrinology	Francis. S. Greenspan & David G	MC graw Hill Co
2	Review of medical physiology	William F. Ganong, M. C	Graw Hill companies
3	Text book of Medical Physiology	Guyton &Hall	Saunders Pb.
4	Comparative vertebrate Endocrinology	Bantley, P.J. (1976)	Cambridge Univ. Press, U.K
5	Text book of Endocrinology	Williams	W.B. Saunders Company

Clinical Laboratory Organization and Management

Course Code	CBH518
Course Title	Clinical Laboratory Organization and Management
Type of course	DSE
L T P	3 0 0
Credits	3
Course prerequisite	B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	The students will be made aware of basic ethics and good lab practices, including awareness/ safety in a clinical lab. In addition, they will understand sample accountability, quality management systems, calibration and validation of clinical laboratory instruments, Laboratory Information system (LIS), Chromatography, and automation in Clinical Biochemistry etc.
Course Outcomes	At the conclusion of the course, the students will: 1. Understand the ethical and clinical responsibilities towards the patient, colleagues and society 2. know the importance of GLP and the merits of GLP 3. Learn the methods of precautions from the pre- post-exposure of immuno-compromised diseases. 4. Understand the importance of quality and quality parameters.

UNIT I

Ethical Principles and standards for a clinical laboratory professional:
Duty to the patient, Duty to colleagues and other professionals, Duty to the society

Good Laboratory Practice (GLP) Regulations and Accreditation:
Introduction to Basics of GLP and Accreditation, Aims of GLP and Accreditation, Advantages of Accreditation, Brief knowledge about National and International Agencies for clinical laboratory accreditation

UNIT II

Awareness / Safety in a clinical laboratory: General safety precautions, HIV: pre- and post-exposure guidelines, Hepatitis B & C: pre- and post-exposure guidelines, Drug-Resistant Tuberculosis

Patient management for clinical sample collection, transportation, and preservation

UNIT III

Sample accountability: Purpose of accountability, Methods of accountability

Sample analysis: Introduction, Factors affecting sample analysis

Reporting results: Basic format of a test report, Reported reference range, Clinical Alerts, Abnormal results, Turnaround time, Results from referral laboratories, Release of examination results, Alteration in reports

Quality Management system: Introduction, Quality assurance, Quality control system, Internal and External quality control, Introduction and importance of calibration and Validation of Clinical Laboratory instruments

UNIT IV

Laboratory Information system (LIS), Hospital Information system (HIS) and financial Management: Introduction, Functions of a laboratory management system, Standards for laboratory management system, Introduction and awareness of financial management in a clinical laboratory

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Medical Laboratories Management- Cost effective methods	Sangeeta Sharma, Rachna Agarwal, Sujata Chaturvedi and Rajiv Thakur	Viva Books Pvt Ltd.
2	Medical Laboratory Technology	K.L. Mukherjee	Jaypee Brothers Medical Publishers(P) Ltd.
3	Clinical Diagnosis & Management by Laboratory methods, 20th Ed.	John Bernard Henary	Sounder Publisher

Pharmacological Biochemistry

Course Code	CBH520
Course Title	Pharmacological Biochemistry
Type of course	DSE
L T P	3 0 0
Credits	3
Course prerequisite	B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	To understand what drugs do to the living organisms and how their effects can be applied to therapeutics
Course Outcomes	At the conclusion of the course, the students will: 1. Understand the pharmacological actions of different categories of drugs 2. Explain the mechanism of drug action at organ system/sub cellular/ macromolecular levels 3. Apply the basic pharmacological knowledge in the prevention and treatment of various diseases. 4. Observe the effect of drugs on animals by simulated experiments.

UNIT 1

General Pharmacology: Introduction to Pharmacology- Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists(competitive and non competitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy

Pharmacokinetics- Membrane transport, absorption, distribution, metabolism and excretion of drugs .Enzyme induction, enzyme inhibition, kinetics of elimination

UNIT 2

Pharmacodynamics- Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. drug receptors interactions signal transduction mechanisms, G-protein–coupled receptors, ion channel receptors, transmembrane enzyme-linked receptors, transmembrane JAK-STAT binding receptors and receptors that regulate transcription factors, dose-response relationship, therapeutic index, combined effects of drugs and factors modifying drug action.

Adverse drug reactions, Drug interactions (pharmacokinetic and pharmacodynamic), Drug discovery and clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, clinical trials and pharmacovigilance phases.

UNIT 3

Pharmacology of drugs acting on the peripheral nervous system:

Organization and function of ANS, Neurohumoral transmission,co-transmission and classification of neurotransmitters, Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics.

d. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral).

e. Local anesthetic agents.

f. Drugs used in myasthenia gravis and glaucoma

UNIT 4

Pharmacology of drugs acting on central nervous system a. Neurohumoral transmission in the C.N.S.special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine. b. General anesthetics and pre-anesthetics. c. Sedatives, hypnotics and centrally acting muscle relaxants. d. Anti-epileptics e. Alcohols and disulfiram

Text & Reference Books:

S. No	Name	Author(S)	Publisher
1.	Basic and Clinical Pharmacology	Bertram, G. Katzung; Susan, B. Masters. & Anthony, J. Trevor	McGraw-Hill, New York
2	Harper's Bio Chemistry	Robert K Murray, David A Bender, Kathleen M. Gotham, Peter J Kennelly, victor W.Rodwell & P.Anthony.Weil.	McGraw Hill
3	Book Chapter: Introduction to Biochemical Pharmacology and Drug Discovery In Drug Discovery Book Edited by Hany El-Shemy	Gabriel Magoma Editor	Intech Open
4	Essentials of Pharmaceutical Biochemistry, 2nd Ed.	Harbans Lal	CBS Publisher
5	Pharmaceutical Biochemistry: ACcomprehensive Approach	Saravanam	PHARMA MED PRESS

Biostatistics

Course Code	MAT515
Course Title	Biostatistics
Type of course	ID
L T P	3 0 0
Credits	3
Course prerequisite	B.Sc. MLS or B.Sc. (Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	To give the knowledge of statistical techniques used in life sciences for simplification of complex things, so that they can be easily understood.
Course Outcomes	At the conclusion of the course, the students will: 1. Able to calculate and apply measures of location and measures of dispersion -- grouped and ungrouped data cases 2. Learn to apply discrete and continuous probability distributions to various business problems. 3. Implement knowledge to compute and interpret the results of Bivariate and Multivariate Regression and Correlation Analysis, for forecasting and also perform ANOVA and F-test

UNIT-I

Data collection, tabulation, Frequency distribution and its graphical representation;
Measures of Central tendency: mean, mode, median;
Measures of Dispersion: range, variance, Standard deviation and Standard error

UNIT II

Probability: Mathematical definition of a probability event; Conditional probability; Additive and Multiple law of Probability;
Theoretical Distributions: Binomial, Poisson and Normal

UNIT III

Null Hypothesis and Level of Significance; Confidence limit and confidence interval; Skewness and Kurtosis moments; Student's t- test (Paired and Unpaired); Chi Square test

UNIT-IV

Correlation: Covariance, Karl pearson's correlation coefficient and Spearmans rank correlation coefficient.
Regression: Least square technique for regression lines, regression coefficient; Relation between Correlation and Regression;

Analysis of variance (one way and two way ANOVA)

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Statistical Methods	S.P Gupta	Sultan Chand & Sons
2	Basic and Clinical Biostatistics, 5th Ed.	Susan white	McGraw Hill Medical
3	Basic Concepts of Biostatistics, 5th Ed.	N. Arumugam,	Saras Publication

Introductory Concepts of Computer Technology

Course Code	CSE554
Course Title	Introductory Concepts of Computer Technology
Type of course	ID
L T P	3 0 0
Credits	3
Course prerequisite	B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	To aware students about the basic fundamentals of computer and its use in day today life.
Course Outcomes	At the conclusion of the course, the students will: 1. Understand Basics of computer and its operating system 2. Distinguish the types of Software 3. Learn the MS-Windows basics and applications

UNIT--I

Evolution of computers; Basics of computer and its operation: Functional Components and their inter-connections, concept of Booting, Use of Operating System for directory listing, hierarchical directory structure, renaming, deleting files/folders, formatting floppy, copying files, concepts of path and pathname, switching between tasks, installation/removal of applications

UNIT--II

Computers and their applications in biology

Operating systems: Need for operating system, Functions of operating system (Processor Management, Memory Management, File Management and Device Management);

Types of operating system - Interactive (GUI based), Timesharing, Real Time and Distributed

Types of Software: System Software, Utility Software and Application Software

UNIT--III

Computer fundamentals, Introduction to digital computers, Organization; Number system, I/O devices, Storage devices; Introduction to internet and its applications – www, email

UNIT--IV

MS-Windows basics

MS-Word: Meaning of Word–Processing, Creating, Saving, Printing documents, Formatting, Spell-Check, Adding page numbers, Header and Footer, Macros, Creating tables, Converting table to text and vice–versa, Mail Merge;

MS-Excel: Spreadsheets, Using different types of formulae, Creating graphs and charts, Exporting charts to MS-Word

MS-PowerPoint: Creating presentations, Formatting, Adding effects and timings

Text & Reference Books:

S.No.	Name/Title	Author	Publisher
1	Computer Fundamentals	Sinha, P.K.	
2	Windows Based Computer Courses	Sumit Kumar,	JBD Publishers
3	Fundamentals of Computers	Rajaraman	Prentice Hall of India

Metabolism of Carbohydrates and Lipids Practical

Course Code	CBH504
Course Title	Metabolism of Carbohydrates and Lipids Practical
Type of course	CC
L T P	0 0 3
Credits	1.5
Course prerequisite	B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	Qualitative and quantitative analysis of biological molecules and their estimation using multiple methods
Course Outcomes	After the course completion, the students will be: 1. Able to perform carbohydrate/glucose estimation from biological samples 2. Learn the procedure of lipids extraction and their separation by TLC. 3. Able to perform biochemical assays for the determination of various types of lipids

List of Experiments:

1. Determination of carbohydrates by the Dubois method and DNS method.
2. Estimation of Blood Glucose level by the Folin Wu method
3. Estimation of blood glucose by glucose oxidase method
4. Demonstration of starch digestion by salivary amylase.
5. Determination of total lipids
6. Extraction of total lipids from egg yolk;
7. Separate different types of lipids using thin-layer chromatography and visualize them
8. Estimation of different types of lipids by biochemical assay.

Text & Reference Books:

S.No.	Name/Title	Author	Publisher
1	Biochemistry Laboratory: Modern Theory and Techniques, 6th Ed.	Boyer, R.F.	Boston, Mass: Prentice Hall, 2012.
2	An Introduction to Practical Biochemistry 3rd Ed.	Plummer D. T	Tata McGraw Hill Education Pvt. Ltd. (New Delhi), 1998
3	Fundamentals of Computers	Rajaraman	Prentice Hall of India

Clinical Biochemistry Practical

Course Code	CBH508
Course Title	Clinical Biochemistry Practical
Type of course	CC
L T P	0 0 3
Credits	1.5
Course prerequisite	B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	The students will learn the quantitative analysis of constituents of biological fluids such as urine, blood and their estimation using standard methods.
Course Outcomes	After the course completion, the students will be: 1. Able to carry out routine biochemical investigations of biological samples such as blood, serum, urine etc. 2. Learn the procedure of lipids extraction and their separation by TLC. 3. Able to perform biochemical assays for the determination of various types of lipids

List of Experiments

1. Determination of total serum proteins and albumins.
2. Determination of serum and urine creatinine.
3. Determination of serum direct and indirect bilirubin
4. Estimation of blood urea by Nesslerization or DAM method
5. Estimation of total Serum Cholesterol
6. Determination of Serum Uric Acid by Henry Caraway's method
7. Demonstration of Glucose Tolerance Test
8. Colorimetric determination of Calcium and phosphorous
9. Estimation of serum electrolytes: sodium, potassium and chloride.

Text & Reference Books:

S.No.	Name/Title	Author	Publisher
1	Biochemistry Laboratory: Modern Theory and Techniques, 6th Ed.	Boyer, R.F.	Boston, Mass: Prentice Hall, 2012.
2	An Introduction to Practical Biochemistry 3rd Ed.	Plummer D. T	Tata McGraw Hill Education Pvt. Ltd. (New Delhi), 1998

3	A Manual of Laboratory & Diagnostic Tests	10. Frances Fischbach	Lippin Cott Wiliam & Wilkins
4.	Medical Laboratory Practices	11. J.Ochei and Kolathkar	Jaypee publisher
5	Text book of Medical Laboratory Technology, Volume 1	12. Paraful B. Godkar, Darshan P. Godkar	Bhalani Publisher
6	Medical laboratory Technology Volume-I	13. KL Mukherjee	Tata Mcgraw Hill
7	Hand book of Medical Laboratory Technology (2nd edition)	V.H. Talib 14.	CBS Publishers & Distributors

Fundamentals of Molecular Biology Practical

Course Code	CBH512
Course Title	Fundamentals of Molecular Biology Practical
Type of course	CC
L T P	0 0 3
Credits	1.5
Course prerequisite	B.Sc. MLT or B.Sc. (Medical/Applied Medical Science/Biosciences/Medical Science & Allied Medical/Life Sciences) with 50% aggregate marks or it is equivalent.
Course Objective	Students will learn the experimental techniques of recombinant DNA technology and their biotechnological applications.
Course Outcomes	After the course completion, the students will be: 1. Able to isolate genomic and plasmid DNA from biological samples. 2. Learn the procedure of separation of DNA fragments by agarose gel electrophoresis. 3. Able to perform transformation of *E.coli* cells 4. Amplification of DNA by PCR

List of Experiments

1. Genomic DNA isolation from blood
2. Plasmid DNA isolation
3. DNA estimation by UV spectrophotometry
4. Agarose gel electrophoresis for separation of DNA fragments.
5. Isolation of plasmid DNA from E. coli.
6. Transformation of E. coli cells with plasmid DNA.
7. Digestion of plasmid DNA with restriction enzymes.
8. Amplification of a DNA fragment by PCR.
9. Complementation of β−galactosidase for Blue and White selection.

Text & Reference Books:

S.No.	Name/Title	Author	Publisher
1	Molecular Cloning: A Laboratory Manual, 3rd Ed.	Sambrrok, J. and Russel, D.W.	Cold Spring harbor Laboratory
2	Molecular Biotechnology: Principles and Applications of Recombinant DNA	Glick & pasternek	ASM Press, Washington , DC