MALLA REDDY VISHWAVIDYAPEETH

SCHOOL OF ALLIED HEALTH SCIENCES AND TECHNOLOGY

Suraram X Roads, Jeedimetla,
Hyderabad-500055
Web: https://mrvv.edu.in/

Program

Master of Medical Laboratory Science

2025

MALLA REDDY VISHWAVIDYAPEETH
SCHOOL OF ALLIED HEALTH SCIENCES AND TECHNOLOGY
MASTERS OF MEDICAL LABORATORY SCIENCES

Vision

To be a center of excellence in Medical Laboratory Sciences by developing advanced, globally competent professionals in diagnostics, research, and quality healthcare.

Mission

To deliver advanced, competency-based training in medical laboratory diagnostics, fostering analytical and research skills, ensuring quality and ethical practice, promoting interdisciplinary collaboration, encouraging innovation, and supporting lifelong professional growth.

Program Educational Objectives (PEOs)

- Apply comprehensive knowledge of medical laboratory sciences for accurate diagnosis and patient care in diverse healthcare settings.
- Demonstrate professional competence, ethical responsibility, and accountability in laboratory practice.
- Engage in multidisciplinary healthcare teams to improve clinical outcomes and healthcare delivery.
- Adapt to advancements in laboratory technologies including automation, molecular diagnostics, and quality assurance systems.
- Contribute to community health through disease prevention, health promotion, and evidence-based practices.
- Pursue lifelong learning, research, and professional development in medical laboratory sciences.

PROGRAM OUTCOMES (POs)

- Apply knowledge of basic and clinical sciences for laboratory diagnosis and interpretation of results.
- Perform laboratory procedures accurately with adherence to quality control and biosafety protocols.
- Analyze, interpret, and correlate laboratory findings with clinical conditions.
- Communicate effectively with patients, clinicians, and healthcare teams.
- Demonstrate ethical practices, professionalism, and accountability in laboratory services.
- Function effectively as a member of a multidisciplinary healthcare team and contribute to patient-centered care.

PROGRAM SPECIFIC OUTCOMES (PSOs)

- Perform hematological, biochemical, microbiological, immunological, and molecular diagnostic tests with precision.
- Operate and maintain laboratory instruments, analyzers, and automation systems efficiently.
- Implement quality assurance (QA) and quality control (QC) practices in laboratory settings.
- Identify and troubleshoot errors in pre-analytical, analytical, and post-analytical phases.
- Apply advanced diagnostic techniques including molecular diagnostics and immunocytochemistry.
- Interpret laboratory data and assist clinicians in disease diagnosis, monitoring, and prognosis.

COURSE OUTCOMES (COs)

- Describe fundamental principles of laboratory sciences including hematology, microbiology, and biochemistry.
- Demonstrate laboratory skills such as specimen collection, staining, microscopy, and biochemical assays.
- Apply analytical techniques to perform routine and specialized laboratory investigations.
- Analyze laboratory results and correlate them with pathological conditions.
- Evaluate quality control data and ensure accuracy and reliability of laboratory reports.
- Develop problem-solving skills for troubleshooting laboratory errors and improving diagnostic efficiency.

MALLA REDDY VISHWAVIDYAPEETH

SCHOOL OF ALLIED HEALTH SCIENCES AND TECHNOLOGY

MASTERS OF MEDICAL LABORATORY SCIENCES

Course Structure

I year I semester

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Max. Marks		
							INT	EXT	TOTAL
1		Research methodology and Biostatistcs	3	-	-	3	40	60	100
2		Immunology	2	-	-	2	40	60	100
3		General & Nutritional Biochemistry	3	-	2	4	40	60	100
4		General Microbiology	2	-	-	2	40	60	100
5		Hematology	2	-	-	2	40	60	100
6		General Pathology	2	-	-	2	40	60	100
7		QC in Clinical Lab	2	-	-	2	40	60	100
8		Clinical Postings-I	-	-	3	3	40	60	100
TOTAL			**16**	**-**	**5**	**20**	**320**	**480**	**800**

I year II semester

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Max. Marks		
							INT	EXT	TOTAL
1		Molecular Biology & Applied Genetics	2	-	-	2	40	60	100
2		Immunopathology & clinical pathology	3	-	1	4	40	60	100
3		Biomedical Techniques & Laboratory Management	3	-	-	3	40	60	100
4		Clinical Biochemistry	3-	-	-	3	40	60	100

5		Clinical biochemistry-I Practical	-	-	2	2	40	60	100
6		Applied Biochemistry-I	3	-	-	3	40	60	100
7		Clinical Postings-II	-	-	3	3	40	60	100
TOTAL			**14**	**-**	**12**	**20**	**280**	**420**	**700**

II year III semester

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Max. Marks		
							INT	EXT	TOTAL
1		Clinical and Applied Biochemistry-II	4	-	-	4	40	60	100
2		Parasitology, Mycology, Virology	3	-	-	3	40	60	100
3		Blood Banking and Immunohematology	3	-	-	3	40	60	100
4		Applied Histopathology & Cytology	2	-	-	2	40	60	100
5		Clinical and Applied Biochemistry-II- Practical	-	-	2	2	40	60	100
6		Applied Histopathology & Cytology practical	-	-	2	2	40	60	100
7		Parasitology, Mycology, Virology practical	-	-	2	2	40	60	100
8		Blood Banking and Immunohematology practical	-	-	2	2	40	60	100
9		Clinical Postings-III	-	-	3	3	100	-	100
TOTAL			**12**	**-**	**11**	**23**	**420**	**480**	**900**

II year IV semester

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Max. Marks		
							INT	EXT	TOTAL
1		Thesis / Research Project	-	-	6	6	40	60	100
2		Cancer epidemiology and Digital Pathology	2	-	-	2	40	60	100
3		Haemostatic and Haematological Disorders	3	-	-	3	40	60	100
4		Immunology and Immunodiagnostics	3	-	1	4	40	60	100
5		Enzymology & Nutrition	2	-	-	2	40	60	100
6		Haemostatic and Haematological Disorders - practical	-	-	2	2	40	60	100
7		Swayam: Basic course in biomedical research							
TOTAL			10		9	19	240	360	600

1.1 Post Graduate Programme

Sl. No.	Course	Duration	Eligibility for admission
1	M.Sc. Medical Labortaory Technology	2 years	Passed BSc in Medical Lab Technology or equivalent examination of a recognized Indian University or a duly constituted Board with pass marks (50%)

1.2. Medium of Instruction:

English shall be the medium of instruction for all subjects of study and for examinations.

1.3. Duration of the Course

Duration details are mentioned under clause no. 1.1 of this booklet.

1.4 Examination Regulations

1.4.1 Attendance: 75% of attendance (physical presence) is mandatory.

Medical leave or other types of sanctioned leaves will not be counted as physical presence. Attendance will be counted from the date of commencement of the session to the last day of the closing of attendance before the final examination.

1.4.2 Internal Assessments:

a) Regular periodic assessment shall be conducted throughout the course. In each semester there will be **two one-hour internal assessments (15 marks each)** and a continuous assessment (10 marks). Thus, a total of 40 marks for the internal exam. (i.e. weightage for internal assessment shall be 40% of the total marks in each subject).

b) **Exam pattern for internal assessment** in each semester will be

(a) Short questions 3 nos. each carrying 5 marks (i.e. 3 x 5=15 marks). Two such internal examinations will be conducted.

(b) Continuous assessment of the student will be done. Students' overall attendance, performance in class, behaviour of the student, presentations, extra-curricular activities etc will be assessed. Continuous assessment carries 10 marks.

(d) Thus, a total of 40 marks for the internal examination. (15+15+10=40 marks). A candidate should secure a minimum of 40% marks in the internal assessment in each subject to be eligible to appear for the University examination

(e) For value added courses, only internal examination will be conducted. The assessment comprised of five assignments/presentations/case presentations each carrying 10 (i.e. 5 x 10 = 50 marks). Final examination will be for 50 marks with 5 questions each carrying 10 marks (5 x 10 = 50 marks). The minimum pass is 40% marks.

1.4.3 University Examinations (External):

a) University Examination shall be conducted at the end of every semester.

b) A candidate who satisfies the requirement of attendance and internal assessment marks, as stipulated by the University shall be eligible to appear for the University Examination.

c) Examination will be of 3 hours duration (for theory). The question pattern for those subjects without practical examination (60 marks) will be (a) Three essay questions out of which the student should answer 2 questions each carrying 10 marks (i.e. 2 x 10 = 20 marks) (b) Eight short note questions out of which the student should attempt six questions, each carrying 5 marks (6 x 5 = 30 marks). (c) Ten very short questions each carrying 1 mark (i.e. 10 x 1 = 10 marks). Thus, a total of 60 marks.

d) The question pattern for practical examination (a) Spotters/major practical/minor practical/case presenting/Viva/practical/log record.

The minimum pass for internal assessment is 40% and for the University Examination is 50%. i.e. a student should score a total of 50% (adding the internal and external examination) to pass in each subject.

SEMESTER I

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Max. Marks		
							INT	EXT	TOTAL
1		Research methodology and Biostatistcs	3	-	-	3	40	60	100
2		Immunology	2	-	-	2	40	60	100
3		General & Nutritional Biochemistry	3	-	1	4	40	60	100
4		General Microbiology	2	-	-	2	40	60	100
5		Hematology	2	-	-	2	40	60	100
6		General Pathology	2	-	-	2	40	60	100
7		QC in Clinical Lab	2	-	-	2	40	60	100
8		Clinical Postings-I	-	-	3	3	40	60	100
TOTAL			**16**	**-**	**5**	**20**	**320**	**480**	**800**

RESEARCH METHODOLOGY AND BIOSTATISTICS

L/T/P/C

3/-/-/3

Learning Objectives:

- Understand research design and methodology
- Learn data collection and analysis techniques
- Study basic statistical concepts
- Develop skills for scientific writing

Learning Outcomes:
Students will be able to:

- Design basic research studies
- Apply statistical tools for data analysis
- Interpret research findings
- Prepare research reports and presentations

(60 hrs)

RESEARCH METHODOLOGY (30 hrs)

- Introduction to research; Types of research; Defining a research question; Qualitative study designs;Quantitative study; Type I and type II bias; Study design: types
- Case study, Case series, longitudinal cohort, Pre post design, Time series design, repeated measures design, Randomized control design.
- Sampling design, calculating minimum sample size based on design
- Measurement: Properties of measurement: reliability, validity, responsiveness, MCID.
- Outcome measures: Use of outcome measures in rehabilitation research
- Research Methods: Designing methodology, Reporting results, Type I and Type II bias.
- Communicating research.
- Evaluating published research: looking at the evidence
- Introduction to evidence-based practice, evaluating evidence
- Asking clinical questions
- Translating of evidence into practice: strategies
- Use of clinical practice guidelines, clinical pathways, prediction rules to inform practice.

BIOSTATISTICS (30 hrs)

- Descriptive Statistics and measurement variability; Inferential Statistics; Comparison of group means: T test; Analysis of variance;
- Multiple comparison tests
- Parametric and non-parametric tests
- Correlations
- Regression
- Analysis of frequencies: Chi square
- Statistical measure of validity and reliability

- Factorial Design analysis
- Power analysis– Determining sample size, Epidemio logical Measures–Rate, Ratio, Proportion,
- Incidence and prevalence, Relative risk, Risk ratio, Odds ratio
- Application of various statistical software.

RECOMMENDED TEXTBOOKS

1. Statistical methods in Biology by Bailey, N.T.J
2. Statistical methods by Gupta, S.P
3. Research Methodology by Kumar, R

IMMUNOLOGY

L/T/P/C
2/-/-/2

Learning Outcomes

- Analyze immune responses in health and disease.
- Correlate immune mechanisms with pathological conditions.
- Evaluate antigen–antibody interactions in diagnostics.
- Interpret immunological laboratory tests.

Learning Objectives

- Describe innate and adaptive immunity.
- Explain structure and function of immune cells and organs.
- Illustrate antigen processing and presentation.
- Outline complement system and cytokines.

(30hrs)

UNIT 1 INTRODUCTION – 4hrs

- History of immunology
- Innate immune system-properties and mechanism, non-specific defense system,
- inflammation.
- Adaptive immune system-properties and mechanism, cells involved, MHC and its role.

UNIT 2 CELLS AND ORGANS OF THE IMMUNE SYSTEM- 5 hrs

- Hematopoeisis
- Cells of the immune system: Lymphoid cells, mononuclear phagocytes, granulocytic cells.
- Primary lymphoid organ: thymus, Bone marrow.
- Lymphatic system Describe blood-lymph circulation and lymphatics.

- Secondary lymphoid organ: Lymph node, Spleen, Mucosal-associated lymphoid tissues (oral, nasopharyngeal, gut-associated, reproductive), CALT.

UNIT 3 B-CELL AND T-CELL RESPONSES- 6 hrs

- Antigens: antigenicity, factors influencing immunogenicity, epitopes, Hapten.
- Antigen processing and presentation.
- Immunoglobulins / antibodies: Structure and function, anotibody mediated effector functions, antibody classes and their biological role, antigenic determinants on Igs (allotype, isotype, idiotype).

UNIT 4 T-LYMPHOCYTE- 4 hrs

- Classification (Th1,Th2, αβ and γδ T cells)
- Markers of T-cell-MHC, CD3, CD4, TCR
- Compare and contrast molecular and cellular features od T cell receptor (TCR) to B cells receptor (Ig molecule)

UNIT 5 DEVELOPMENT OF T CELL AND B CELL – 3 hrs

- Generation, maturation, activation, proliferation and differentiation

UNIT 6 COMPLEMENT SYSTEM – 4 hrs

- Complement activation
- Classical complement pathway
- Alternate complement pathway
- Infectious agents and products that activate complement
- Biological effects mediated by complement
- Effects of complement on the immune system.
- Significance of complement at oral mucosal surfaces.

UNIT 7: HYBRIDOMA, CYTOKINES & ANTIBODY DIVERSITY- 4 hrs

- Hybridoma technology and Mab and its applications. Antibody diversity.
- Cytokines.

RECOMMENDED TEXT BOOKS

• Janeway's Immunobiology by Ken Murphy, Paul Travers, Mark Walport,
• Kuby Immunology by Jenni Punt, Sharon A. Stranford, Patricia P. Jones, Judith A. Owen
• Roitt's Essential Immunology

GENERAL AND NUTRITIONAL BIOCHEMISTRY

L/T/P/C
3/-/2/4

Learning Outcomes

- Analyze metabolic pathways and their regulation.
- Correlate biochemical alterations with diseases.
- Evaluate nutritional deficiencies and metabolic disorders.
- Interpret biochemical test results.

Learning Objectives

- Describe metabolism of carbohydrates, lipids, and proteins.
- Explain enzyme kinetics and regulation.
- Outline molecular biology concepts (DNA, RNA).
- Discuss nutritional requirements and deficiencies.

(60 hrs)

UNIT – I: CELL + CARBOHYDRATE METABOLISM- 10 hrs

- Structure of Cell and intracellular organelles.
- Chemistry of Carbohydrates, Carbohydrate Metabolism: Glycolysis, TCA cycle, Glycogen, Gluconeogenesis, blood glucose regulation, diabetes mellitus.

UNIT – II: LIPID METABOLISM – 8 hrs

- Chemistry of lipids, Lipid Metabolism: Synthesis and breakdown of fatty acids, ketone bodies, DKA
- Cholesterol, bile acids, lipoproteins, atherosclerosis.

UNIT -III: PROTEIN & AMINO ACID METABOLISM – 9 hrs

- Proteins: Structure, classification, properties, functions and Separation techniques.
- Protein Metabolism: Synthesis and breakdown of amino acids, urea cycle, specialized products from amino acids.

UNIT – IV: NUCLEIC ACID & MOLECULAR BIOLOGY- 8 hrs

- Nucleic Acids: Structure, classification, properties, functions and Separation techniques.
- Molecular Biology: Structure and functions DNA, organization and replication, transcription, protein synthesis.

UNIT – V: ENZYMES & ENZYME KINETICS -9 hrs

- Enzymes: Classification, factors that alter enzymes catalyzed reaction,
- Michaelis - Menten Equation, Competitive and non-competitive inhibition of enzyme reactions, regulation of enzyme activity, Isoenzymes-separation and identification, plasma enzymes in clinical diagnosis, Coenzymes.

UNIT-VI : BIOGENETICS & OXIDATIVE PHOSPHORYLATION -8 hrs

- Bioenergetics and Oxidative phosphorylation, free energy-exergonic and endergonic reaction, high energy phosphates, components of electron transport chain mechanism of ATP production, Chemiosmotic theory, inhibitor of respiratory chain.

UNIT-VII: NUTRITION & DEFICIENCY DISORDER- 8 hrs

- Nutritional requirements of carbohydrates, proteins and lipids.
- Deficiency states of carbohydrates, proteins and lipid.
- RDA, Nutritional requirements of vitamins (fat and water soluble) - Structure, functions, deficiency states, dietary source.
- Nutritional requirements of macro and microelements- functions, deficiency states, dietary source & RDA.

PRACTICALS: 30 hrs

• Normal and abnormal constituents of Urine
• Qualitative analysis and identification of Glucose, proteins, urea and creatinine

RECOMMENDED TEXT BOOKS

1. Textbook of biochemistry by U. Sathyanarayana
2. Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox.

GENERAL MICROBIOLOGY

L/T/P/C
2/-/-/2

Learning Outcomes

- Analyze microbial growth and control methods.
- Correlate microbial infections with laboratory diagnosis.
- Evaluate sterilization and disinfection techniques.
- Apply biosafety and waste management practices.

Learning Objectives

- Describe classification and structure of microorganisms.
- Explain culture techniques and growth patterns.

- Outline sterilization and disinfection methods.
- Discuss infection transmission and prevention.

(30hrs)

UNIT I: INTRODUCTION, CLASSIFICATION & MICROSCOPY- 4 hrs

- Introduction and history of microbiology
- Classification of microorganism and structure of bacteria
- Microscopy and types of microscopy

UNIT II: GROWTH, NUTRITION & CULTURE METHODS- 5 hrs

- Nutrition, growth and multiplication of bacteria, bacteria growth curve
- Culture medias
- Culture method

UNIT III: STERILIZATION & DISINFECTION – 5 hrs

- Classification of sterilization and disinfection
- Sterilization: different methods of sterilization, principles and use of equipment's of sterilization – hot air over & autoclave in detail.
- Disinfection: commonly used chemical disinfectant and their uses

UNIT IV: IMMUNOLOGY BASICS – 6 hrs

- Immunology – classification and types
- Antigen
- Antibody
- Antigen-antibody reaction
- Hypersensitivity reactions
- Immunization schedule

UNIT V: INFECTION & EPIDEMIOLOGY- 5 hrs

- Infection – definition, types, sources and mode of transmission.
- Hospital acquired infections
- Types of infectious diseases – outbreak, endemic, epidemic, pandemic.

UNIT VI: BIOMEDICAL WASTE & BIOSAFETY – 5 hrs

- Biomedical waste management: principles & practices
- Standard precautions
- Hand hygiene technique and body fluids spill management
- Needle stick injury management.

RECOMMENDED TEXT BOOKS

• Ananthanarayan and Paniker's Textbook of Microbiology
• Prescott's Microbiology

HAEMATOLOGY

L/T/P/C
2/-/-/2

Learning Outcomes

- Analyze hematological disorders and laboratory findings.
- Correlate blood cell abnormalities with diseases.
- Interpret hematological test results.
- Evaluate diagnostic approaches in hematology.

Learning Objectives

- Describe hematopoiesis and RBC/WBC development.
- Explain classification of anemia and leukemias.
- Outline coagulation and hemorrhagic disorders.
- Discuss bone marrow examination.

(30hrs)

UNIT 1: HEMATOPOIESIS & RBC BASICS – 5hrs

- Haematopoesis: Origin, development, function and fate of blood cells.
- Erythropoiesis: Origin, Development of RBCs, biosynthesis of Hb, control of erythropoiesis
- Disorders of Red blood cells, erythrocyte indices, red cell inclusion bodies and structure disorders

UNIT 2: ANEMIAS & RBC DISORDERS- 8 hrs

- Anaemia, defrinition, pathophysiology, classification – morphologic and etiologic classification and clinical features. Investigations in a case of anaemia.
    1. Morphologic: microcytic, hypochromic anaemia, macrocytic anaemia.
    2. Haemolytic anaemias: definition, classification, clinical features.
    3. Inverstigation to establish a case of hemolytic anaemia.
- Aplastic anemia. Pancytopenia, anemia due to abnormal globin synthesis.
- Polycythaemia.

UNIT 3 DISORDERS OF WHITE BLOOD CELLS – 7hrs

- Leucocytosis, leucopenia, leukaemoid reaction, myelodysplastic syndrome (MDS).
- Leukaemias – definition, etiology, clinical features.
- Classification – [French -American British – FAB classification] Lab investigations.
- Cytochemistry of acute leukaemis

- Chronic myeloid leukaemia – clinical presentation, investigations.
- Chronic lymphocytic leukaemia.

UNIT 4: PLASMA CELL & PROLIFERATIVE DISORDERS – 5 hrs

- Plasma cell disorders: classification. Plasma cell myeloma: definition, clinical classification, investigations.
- Myelo proliferative disorders: general features, classification and investigations.
- Lympho proliferative disorders: general features, classification, investigations.
- Bone marrow examination

UNIT 5 HAEMORRHAGIC DISORDERS – 5hrs

- Definition – pathogenesis, clinical feature, classification,- vascular disorders, platelet disorders, coagulation disorders, fibrinolysis.
- Normal haemostasis.
- Investigation of haemorrhagic disorders
- Tests of vascular and platelet aggregation studies.
- Tests of coagulation disorder.

RECOMMENDED TEXT BOOKS

• Williams Hematology
• Wintrobe's Clinical Hematology
• Dacie and Lewis Practical Haematology

GENERAL PATHOLOGY

L/T/P/C
2/-/-/2

Learning Outcomes

- Analyze mechanisms of disease processes.
- Correlate pathological changes with clinical conditions.
- Interpret laboratory investigations in pathology.
- Evaluate specimen handling and diagnostic techniques.

Learning Objectives

- Describe cell injury and inflammation.
- Explain neoplasia and cancer biology.

- Outline blood banking principles.
- Discuss specimen collection and processing.

(30hrs)

UNIT I: CELL INJURY, INFLAMMATION & BASIC PATHOLOGY- 8 hrs

- Introduction to pathology
- General introduction to pathology, cell injury and necrosis, gangrene
- Apoptosis and sub-cellular responses to cell injury
- Cellular responses to growth and differentiation, intracellular accumulations, pathologic calcification
- Acute and chronic inflammation, morphologic patterns of acute and chronic inflammation

UNIT II: HEMATOLOGY BASICS & NEOPLASIA- 10 hrs

- Normal constituents of blood, their structure and functions
- Collection of blood samples.
- Various anticoagulant used in haematology
- Haemotology estimation, different methods and normal values
- Hemoglobin estimation, different methods and normal values
- RBC count
- WBC count
- Platelet count
- Neoplasia, nomenclature, characteristics of benign and malignant neoplasms
- Molecular basis of cancer, oncogenes and cancer, protein products of oncogene
- Activation of oncogenes, point mutation, chromosomal rearrangements, gene amplification, cancer.

UNIT III: BLOOD BANKING- 5hrs

- Introduction to blood banking
- Blood group system: ABO & RH system
- Methods of blood grouping: forward & reverse
- Donor selection criteria
- Collection and processing of blood for transfusion.

UNIT IV: CLINICAL SPECIMENS & INFECTIOUS DISEASES- 7hrs

- Collection, transport, preservation and processing of various clinical specimens.
- Urine
- CSF
- Stool
- Sputum

- Body fluids
- Urine examination- collection & preservation. Physical, chemical and microscopic examination for abnormal constituents.
- Infectious diseases, new and emerging infectious diseases, categories of infectious diseases in brief, special techniques for diagnosing infections.
- Tuberculosis-etiology, pathogenesis and lab diagnosis
- Leprosy – etiology, pathogenesis and lab diagnosis
- HIV – epidemiology, pathogenesis and lab diagnosis

RECOMMENDED TEXT BOOKS

• Robbins and Cotran Pathologic Basis of Disease

• Harsh Mohan's Textbook of Pathology

QUALITY CONTROL IN CLINICAL LAB

L/T/P/C
2/-/-/2

Learning Outcomes

- Evaluate quality assurance systems in laboratories.
- Analyze sources of laboratory errors.
- Implement quality control measures.
- Ensure laboratory safety and compliance.

Learning Objectives

- Describe concepts of quality management.
- Explain internal and external quality control.
- Identify laboratory hazards and safety measures.
- Outline method validation procedures.

(30 hrs)

UNIT – I: LABORATORY OPERATIONS & METHOD EVALUATION - 5 hrs

- Laboratory Operation:
  Selection and evaluation of methods: Basic concepts, accuracy-reference methodology systematic error, analytical range, sensitivity and speciality, detection limit, interferences within run-precision, recovery.

UNIT-II: METHOD ACCEPTABILITY & LIS- 4 hrs

- Assessing method acceptability:
  • Establishment and use of reference value
  • Clinical laboratory information-computer system, micro-computer applications laboratory information systems, future use of computers.

UNIT-III: LABORATORY MANAGEMENT & SAFETY – 7 hrs

- Laboratory Management and Safety:
  Health care delivery and financial strategies for manged care, financial management, human resource management and space and facility management, Lab safety-safety program, safety equipments, chemical hygiene plan. Hazards in the laboratory-identification of hazards, chemical hazards, clinical hazards, electrical hazards, biology hazards. Prevention of hazards.

UNIT-IV: QUALITY MANAGEMENT SYSTEMS – 7hrs

- Quality management: Fundamentals, total quality management, total testing process, control of pre-analytical and analytical variables, control of analytical quality using stable control materials, external quality assessment, **documentation of reports, proficiency testing new quality initiatives.**

UNIT-V: LABORATORY SAFETY & HAZARD CONTROL – 4 hrs

- Laboratory safety: Fire, chemical, radiation and infection control (body substance precautions0, hazardous waste and transport of hazardous materials.

UNIT-VI: ETHICS & QUALITY ASSURANCE – 3hrs

- Professional ethics
- Quality Assurance: total quality management, development and monitoring of performance indicators.

RECOMMENDED TEXT BOOKS

1. Textbook of Medical Laboratory Technology by Praful B. Godkar, Darshan P. Godkar
2. Quality Control in Laboratory edited by Sarwar Zaman

CLINICAL POSTINGS I

L/T/P/C
-/-/6/3

Learning Outcomes

- Perform routine laboratory procedures under supervision.
- Apply theoretical knowledge in clinical settings.
- Demonstrate professional behavior in labs.
- Maintain laboratory records accurately.

Learning Objectives

- Observe workflow in different lab sections.
- Assist in specimen processing and testing.
- Follow biosafety protocols.
- Document procedures and results.

(45 hrs)

- Biochemistry Lab
- Microbiology lab
- Pathology lab
- Blood bank

SEMESTER – 2

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Max. Marks		
							INT	EXT	TOTAL
1		Molecular Biology & Applied Genetics	2	-	-	2	40	60	100

2		Immunopathology & clinical pathology	3	-	1	4	40	60	100
3		Biomedical Techniques & Laboratory Management	3	-	-	3	40	60	100
4		Clinical Biochemistry	3-	-	-	3	40	60	100
5		Clinical biochemistry-I Practical	-	-	2	2	40	60	100
6		Applied Biochemistry-I	3	-	-	3	40	60	100
7		Clinical Postings-II	-	-	3	3	40	60	100
TOTAL			**14**	**-**	**6**	**20**	**280**	**420**	**700**

MOLECULAR BIOLOGY AND APPLIED GENETICS

L/T/P/C
2/-/-/2

Learning Outcomes

- Analyze genetic mechanisms and molecular techniques.
- Interpret genetic disorders and diagnostic tests.
- Apply recombinant DNA technology concepts.
- Evaluate molecular diagnostic methods.

Learning Objectives

- Describe DNA structure and replication.
- Explain transcription and translation.
- Outline mutation and DNA repair.
- Discuss PCR and genetic applications.

(30hrs)

UNIT-I: ETHICS & QUALITY ASSURANCE- 7 hrs

- DNA- structure, types, coiling and supercoiling, topoisomerases, replication, Satellite DNA. Organization of prokaryotic and eukaryotic genome, Chromosome analysis, chromosome banding, FISH, CGH, flow, cytometry, cell cycle, mitosis and meiosis.

UNIT-II: TRANSCRIPTION, TRANSLATION & GENE REGULATION – 6 hrs

- Transcription and Translation: Factors involved, RNA processing, types of RNA, genetic code, Lac operon, Tryptophan operon, regulation in eukaryotes, gene dosage and gene amplification, generation of antibody diversity.

UNIT-IMUTATION & DNA REPAIR -5 hrs

- Mutation: spontaneous, incluced, point mutation and silent mutation, frame-shift mutation, physical and chemical mutagens, molecular basis, site directed mutagenesis significance of mutagenesis, DNA repair, isolating mutants, Ames test.

UNIT-IV: RECOMBINANT DNA TECHNOLOGY- 7 hrs

- Recombinant DNA Technology: necessary elements-enzymes and their properties. DNA ligase, DNA modifying enzymes, cloning vectors plasmids, cosmids, bacteriophages, shuttle vectors, expression vectors, construction of rDNA and cloning strategies-various methods, genemoic libraries (eg. Using phage vectors). cDNA libraries, introduction of rDNA into host methods, restriction maps and sequencing.

UNIT-V: GENETICS IN MEDICINE – 5 hrs

- Genetics in Medicine: Haemoglobin and haemoglobinopathies, phenylketonuria, alkaptonuria, homocystinuria, Lesch-Nyhan syndrome, genetics for cancer, Down's syndrome, Di-george syndrome, Klinefelter's syndrome, Turner's syndrome, hermaphroditism, cystic fibrosis, haemophilia, prenatal diagnosis of genetic diseases, application of recombinant DNA technology in medicine- PCR, RFLP, DNA finger printing, therapeutic proteins, transgenic organisms, gene therapy, human genome project.

RECOMMENDED TEXT BOOKS

• Molecular Biology of the Cell by Alberts B, Johnson A, Lewis J, Raff M, Roberts K and Walter P
• Lewin's Essential Genes
• Molecular Biology: Principles and Practice by Michael M. Cox, Jennifer Doudna, and Michael O'Donnell.

IMMUNOPATHOLOGY AND CLINICAL PATHOLOGY

L/T/P/C
3/-/2/4

Learning Outcomes

- Analyze immune-related diseases.
- Correlate clinical pathology findings with diagnosis.
- Interpret laboratory tests of body fluids.
- Evaluate immunological diagnostic techniques.

Learning Objectives

- Describe autoimmune and hypersensitivity disorders.
- Explain clinical pathology investigations.
- Outline body fluid analysis.

- Discuss diagnostic instrumentation.

(60hrs)

UNIT 1 ANTIBODY-MEDIATED & IMMUNE DISORDERS -12 hrs

- Mechanism of Ab-mediated inactivation: direct and indirect eg. Diabetes mellitus, thyroid diseases, pernicious anemia, infertility, haemophilia, myasthenia gravis.
- Immune deficeincy disorders
- Autoimmune diseases-organ specific and systemic.
- Autoallergic diseases: encephalomyelitis, multiple sclerosis, oorchitis, thyroiditis, sjogren's syndrome.

UNIT 2: IMMUNOHAEMATOLOGY & HYPERSENSITIVITY REACTIONS -10 hrs

- Immunohaematologic diseases: transfusion reactions, erythroblastosis foetails, agranulocytosis, thrombocytopenic purpura
- Atopic anaphyllactic reactions: reaginic antibody, anaphylaxis, atopic allery – factors involved, asthma, hay fever, food allergy, insect allergy, atopic eczma, delayed hypersensitivity reactions, contact dermatitis
- Different types of Ag-Ab reactions, Principle and Application
- Immunohaematology- Campatibility testing

UNIT 3: IMMUNE COMPLEX & SYSTEMIC DISORDERS -12 hrs

- Immune complex reactions: arthus reaction, serum sickness
- Connective tissue diseases: Arteritis, SLE, rheumatic fever, rhematoid arthritis
- Granulomatous reactions: Infectious diseases like tuberculosis, leprosy
- Immunology of AIDS, Tumour and Tumour markers
- Clinical transplantation-Kidney, Bone marrow, Heart

UNIT 4: CLINICAL PATHOLOGY – SAMPLE ANALYSIS – 14 hrs

- Quality control in clinical pathology, concepts of quality of care, quality improvement approaches, quality improvement tools, introduction to NABH guidelines
- Urine-sample collection & storage, physical and chemical properties and urine microscopic examination
- Semen analysis – collection, count, motility and morphology, CASA
- Examination of body fluids, CSF, peritoneal, pleural and pericardial fluids, synovial and other body fluids

UNIT 5: LABORATORY EQUIPMENT & AUTOMATION - 12 hrs

- Equipment relevant to lab haematology, clinical pathology and transfusion medicine including microscope: light phase contrast, interference, fluorescence, polarization and electron microscopy (principle, parts and its application) Dark ground microscopy, phase contrast microscopy

- Automated and semi-automated urine analyser, automated coagulation analyser, platelet aggregometry and thromboelastogram

PRACTICALS:

- Urine examination, physical, chemical and microscopic. Urine examination by strip method. Urine test for haemosiderin pigment.
- Stool examination – concentration method.
- Sputum examination – microscopic and AFB staining and eosinophils.
- Examination of cerebrospinal fluid
- Pregnancy test.
- Examination of semen.

RECOMMENDED TEXT BOOKS

• Robbins and Cotran Pathologic Basis of Disease
• Janeway's Immunobiology
• Essentials of Clinical Pathology

BIOMEDICAL TECHNIQUES AND LABORATORY MANAGEMENT

L/T/P/C
3/-/-/3

Learning Outcomes

- Apply advanced laboratory techniques.
- Evaluate analytical instruments and automation.
- Implement laboratory management principles.
- Ensure quality and safety in lab operations.

Learning Objectives

- Describe chromatography and electrophoresis.
- Explain spectrophotometry and analytical methods.
- Outline laboratory management systems.
- Discuss automation and quality assurance.

(45 hrs)

UNIT -1GENERAL LAB TECHNIQUES & BASICS -7 hrs

- General Laboratory Techniques and procedures: Chemicals and related substance, general laboratory supplies, volumetric equipments and its calibration, centrifuges, balances and weighing, concept of solute and solvent, buffer solutions and their actions, physical and chemical units, units of measurements, safety measures.

UNIT-2 SPECIMEN COLLECTION & PRE-ANALYTICAL PHASE - 6hrs

- Specimen collection and processing: Collection and preservation of blood, urine and other body fluids, sources of biological variations, pre-analytical variables.

UNIT-3 ANALYTICAL TECHNIQUES & INSTRUMENTATION- 14hrs

- Analytical Techniques: Photometry, Spectrophotometry, flame emission Spectrophotometry, atomic absorption Spectrophotometry, fluorimetry, nephelometry, turbidimetry, flow cytometry
- Radioactivity- radioisotopes, half-life units, Geiger Mueller counter, gamma counter and scintillation.
- Electrochemistry – potentiometry, biosensors.
- Chromatography – Theory, description of techniques of various types of chromatography, paper chromatography, HPLC.
- Electrophoresis – Theory, description of techniques of various types of electrophoresis, technical considerations, capillary electrophoresis.
- Immunochemical techniques – basic concepts, antigen-antibody binding qualitative methods, quantitative methods.
- Centrifuge – basic principles, types of centrifuges and their applications.
  Protein purification.

UNIT -4 MOLECULAR TECHNIQUES & AUTOMATION – 8hrs

- Recombinant DNA technology – PCR, western blotting, northern blotting and southern blotting, FISH.
  Automation: Concepts, automation of analytical processes, integrated automation for clinical laboratory, automation of point of care analyzers.

UNIT -5 LAB MANAGEMENT, QA & SAFETY-10 hrs

- Preparation of operating budgets; general aspects of financial management of laboratories

- Cost-analysis (tests and instruments); justification of providing new services or rejecting existing ones; lease and purchase decision analysis; delegation of budget responsibilities, work load statistics.
- Laboratory safety: Fire, chemical, radiation and infection control (body substance precautions), hazardous waste and transport of hazardous materials.
- Maintenance of records: Procedure manuals, ward manuals, quality control programs, patient data retrieval.
- Personnel management: Personnel policy manual; job descriptions; labor, supervision relations; conducting job interviews; motivation, recognizing job distress syndrome; delegation to a laboratory manager.
- Hospital organization; interactions between the laboratory service and the rest of the hospital.
- Professional ethics.
- Quality assurance; total quality management; development and monitoring of performance indicators.

RECOMMENDED TEXT BOOKS

• Wilson and walker's principles and techniques of biochemistry and molecular biology.

• Bishop's techniques and principles of molecular biochemistry.

CLINICAL BIOCHEMISTRY I

L/T/P/C
3/-/-/3

Learning Outcomes

- Analyze biochemical changes in diseases.
- Interpret enzyme and metabolic test results.
- Evaluate organ function tests.
- Apply biochemical diagnostic techniques.

Learning Objectives

- Describe metabolic disorders.
- Explain enzyme assays.
- Outline electrolyte balance.
- Discuss liver and renal function tests.

(45 hrs)

UNIT -1- CARBOHYDRATE METABOLISM & DIABETES-10hrs

- Disorders of carbohydrate metabolism
- Diabetic panel test
- Glucose tolerance test (GTT) importance and principle and techniques of GTT
- Insulin tolerance test

UNIT 2: PROTEINS & LIPID METABOLISM -7 hrs

- Abnormalities of proteins in plasma
- Disorders of plasma lipids and lipoproteins

UNIT 3: ELECTROLYTES & ACID-BASE BALANCE- 8 hrs

- Water and Electrolyte balance and imbalance: sodium, potassium, chloride, CO2 (HCO3-), calcium, phosphorus, magnesium

UNIT 4: LIVER FUNCTION & ENZYMOLOGY- 10hrs

- Bile pigment metabolism and Pathophysiology of jaundice
- Enzymes and Iso-enzymes of clinical Importance (ALP, ACP, SGOT, SGPT, CPK, LDH)

UNIT 5: CLINICAL TESTS & BODY FLUID ANALYSIS- 10hrs

- Gastric juice analysis
- Clearance test for urine function
- Qualitative and quantitative test of urine

RECOMMENDED TEXT BOOKS

• Lippincott's illustrated biochemistry
• Harper's illustrated review of biochemistry

CLINICAL BIOCHEMISTRY I - PRACTICALS

L/T/P/C
-/-/4/2

(60 hrs)

1. Estimation of SGOT in blood sample
2. Estimation of SGPT in blood sample
3. Estimation of alkaline phosphatase in blood sample
4. Estimation of acid phosphatase in blood sample

5. Estimation of bilirubin in blood sample
6. Estimation of Na+, K+ & Ca++
7. Estimation of common parameters in urine

RECOMMENDED TEXT BOOKS

• Lehninger Principles of Biochemistry
• Harper's Illustrated Biochemistry

APLLIED BIOCHEMISTRY - I

L/T/P/C
3/-/-/3

Learning Outcomes

- Analyze biochemical basis of diseases.
- Evaluate toxicological conditions.
- Interpret biomarkers in clinical diagnosis.
- Correlate biochemical findings with clinical conditions.

Learning Objectives

- Describe acute phase proteins.
- Explain biochemical aspects of HIV.
- Outline ageing and metabolic changes.
- Discuss toxicology principles.

(45 hrs)

UNIT I ACUTE PHASE PROTEINS- 8 hrs

- Diagnosis & clinical significance of C-reactive proteins, Alpha fetoproteins, Alpha 1 antitrypsin, Alpha 2 Macroglobulin, Haptoglobin, Ceruloplasmin.

UNIT II BIOCHEMISTRY OF AIDS – 7 hrs

- HIV genes & gene products, Biochemical changes during HIV infection, diagnosis & precautions.

UNIT III AGEING – 7 hrs

- Biochemistry of ageing, Alzheimer's disease, Prions, Beta-amyloid

UNIT IV BLOOD & DISORDERS – 11 hrs

- Biochemical derangement in anemia, Conditions associated with abnormal acid base status, Abnormal electrolytes composition of the blood, Diagnosis of acid base disorders.

UNIT V CLINICAL TOXICOLOGY- 12 hrs

- History of Toxicology, Concept & Scope of toxicology, Factors modifying action of poisons, fatal dose, house hold plants, house old chemicals, agricultural chemicals.
- Drugs of abuse – Amphitamine, Cannabissativa, Cocaine, Lysergic acid, Diethylamide, Mescaline, Methaqualone, Phincyclidine, Nutmeg, Asthma powder, Tolatile nitrites, Poisones mushrooms.

RECOMMENDED TEXT BOOKS

• U.Sathyanarayana – textbook of biochemistry
• Rafi MD textbook of biochemistry

CLINICAL POSTINGS- II

L/T/P/C
-/-/6/3

Learning Outcomes

- Perform advanced laboratory techniques.
- Interpret clinical test results.
- Apply quality control in real settings.
- Demonstrate interdisciplinary coordination.

Learning Objectives

- Assist in specialized diagnostic tests.
- Follow SOPs in clinical labs.
- Maintain documentation.
- Observe advanced instrumentation.

(90 hrs)

Students should be posted in,

- Biochemistry lab.
- Pathology lab.
- Blood bank.
- Molecular biology lab
- Microbiology l

SEMESTER III

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Max. Marks		
							INT	EXT	TOTAL
1		Clinical and Applied Biochemistry-II	4	-	-	4	40	60	100
2		Parasitology, Mycology, Virology	3	-	-	3	40	60	100
3		Blood Banking and Immunohematology	3	-	-	3	40	60	100
4		Applied Histopathology & Cytology	2	-	-	2	40	60	100
5		Clinical and Applied Biochemistry-II- Practical	-	-	2	2	40	60	100
6		Applied Histopathology & Cytology practical	-	-	2	2	40	60	100
7		Parasitology, Mycology, Virology practical	-	-	2	2	40	60	100
8		Blood Banking and Immunohematology practical	-	-	2	2	40	60	100
9		Clinical Postings-III	-	-	3	3	100	-	100
TOTAL			12	-	11	23	420	480	900

ADVANCED CLINICAL AND APPLIED BIOCHEMISTRY- II

Course Rationale

This course provides advanced knowledge in clinical and applied biochemistry with emphasis on organ function tests, toxicology, metabolic regulation, hormones, tumor biomarkers, pediatric biochemistry, vitamins, minerals, and inborn errors of metabolism. It integrates biochemical principles with laboratory diagnostics, quality control, and clinical applications relevant to healthcare and medical laboratory sciences.

Learning Outcomes

At the end of the course, students will be able to:

1. Analyze biochemical parameters related to organ function and metabolic disorders.
2. Interpret tumor biomarkers, toxicological findings, and pediatric biochemical variations.
3. Evaluate drug metabolism, hormonal disorders, and inborn errors of metabolism.
4. Apply advanced biochemical and toxicological diagnostic techniques in clinical laboratories.
5. Implement quality control, laboratory safety, and hazard management procedures in biochemistry laboratories.

UNIT I: Organ Function Tests and Pediatric Clinical Biochemistry

12 Hours

Organ Function Tests

- Pancreatic function tests
- Thyroid function tests
- Liver function tests

Pediatric Clinical Biochemistry

- Problems of specimen collection and capillary specimens
- Age- and sex-related reference range variations
- Respiratory distress syndrome
- Gastrointestinal disorders: fat absorption defects, disaccharide intolerance, protein-losing conditions

UNIT II: Quality Control, Laboratory Safety, and Acid-Base Balance

10 Hours

Quality Control and Laboratory Safety

- Internal and external quality control
- Hazards in clinical biochemistry laboratories
- Handling and disposal of infectious and radioactive materials

Acid-Base Balance and Gas Transport

- Gas transport mechanisms
- Plasma buffer systems
- pH regulation

- Acid-base balance and maintenance

UNIT III: Tumor Biomarkers and Drug Metabolism

12 Hours

Tumor Biomarkers

- Classification and biochemical basis of tumor markers
- Protein and carbohydrate tumor markers
- PSA, calcitonin, hCG, AFP, CEA, CA 15-3, CA 125, CA 19-9
- Proteomic approaches for cancer detection

Drug Metabolism

- Phase I and Phase II drug metabolism reactions
- Drug-metabolizing enzymes and interindividual variability
- Effects of competing metabolic pathways on drug efficacy and toxicity

UNIT IV: Toxicology and Emergency Biochemistry

12 Hours

Toxicologic Syndromes

- Cholinergic syndrome
- Anticholinergic syndrome
- Sympathomimetic syndrome
- Opiate syndrome
- Sedative-hypnotic syndrome

Laboratory Evaluation of Poisoned Patients

- Emergency toxicology guidelines
- Blood and urine analysis for xenobiotics
- Toxicological screening panels
- Toxicological profiles of acetaminophen, salicylates, alcohols, glycols, barbiturates, antidepressants, carbon monoxide, organophosphates, digoxin, lead, iron, and cyanide
- Supportive therapy and antidotal treatment
- Hemodialysis, plasmapheresis, exchange transfusion, charcoal hemoperfusion

UNIT V: Vitamins, Minerals, Hormones, and Inborn Errors of Metabolism

14 Hours

Vitamins and Minerals

- Chemistry, absorption, metabolism, and biochemical roles of vitamins
- Vitamin deficiencies and estimation methods
- Macro, trace, and ultra-trace elements
- Toxic effects of metals
- Estimation of Zn, Cu, Na, K, Cl, Mg, Mn, Ca, P, I, Fe
- Iron binding capacity, transferrin, ferritin, ceruloplasmin

Hormones and Metabolic Disorders

- Mechanism of hormone action
- Hormone receptors and signal transduction
- Cyclic AMP and cyclic GMP
- Biosynthesis of adrenal and thyroid hormones
- Hormonal regulation of gene expression
- Hormonal disorders

Inborn Errors of Metabolism

- Disorders of carbohydrate metabolism
- Lipid metabolism disorders
- Protein and amino acid metabolic disorders
- Nucleic acid metabolic disorders
- Vitamin and mineral metabolic disorders
- Hormone metabolism disorders

PRACTICALS

Advanced Clinical and Applied Biochemistry Practical

1. Electrophoresis of serum proteins.
2. Determination of serum thyroxin-binding capacity.
3. Estimation of serum bicarbonate.
4. Estimation of T3, T4, and TSH.
5. Liver function test analysis.
6. Pancreatic enzyme assay interpretation.
7. Quality control chart preparation and interpretation.
8. Acid-base balance and blood gas analysis interpretation.
9. Estimation of serum electrolytes and minerals.
10. Detection and interpretation of tumor biomarkers.
11. Toxicological screening methods for poisoned patients.
12. Estimation of serum iron, ferritin, transferrin, and iron-binding capacity.
13. Case studies in metabolic and hormonal disorders.
14. Laboratory safety and hazardous waste disposal procedures.
15. Clinical case interpretation and report writing.

Suggested Readings

1. Lippincott Illustrated Reviews: Biochemistry
2. Harper's Illustrated Biochemistry
3. Textbook of Biochemistry
4. Textbook of Biochemistry

PARASITOLOGY, MYCOLOGY, VIROLOGY

L/T/P/C
3/-/-/3

Learning Outcomes

- Analyze parasitic, fungal, and viral infections.
- Correlate pathogens with disease manifestations.
- Interpret microbiological diagnostic tests.
- Evaluate laboratory identification techniques.

Learning Objectives

- Describe life cycles of parasites.
- Explain fungal and viral classification.
- Outline diagnostic techniques.
- Discuss epidemiology of infections.

UNIT I: GENERAL PARASITOLOGY& PROTOZOA- 9 hrs

- Introduction to parasitology: definitions, history, significance; host–parasite relationships; zoonoses; epidemiology of parasitic diseases
- Morphology, structure, life cycle, pathogenesis of medically important protozoa (e.g. Plasmodium spp., Leishmania, Trypanosoma, Entamoeba histolytica, Giardia, Trichomonas); Classification – protozoa-amoeba, flagellates, sporozoa, ciliates.
- Opportunistic parasitic infection

UNIT 2: HELMINTHS& DIAGNOSTIC PARASITOLOGY -9 hrs

- Helminths – cestodes, termatodes.
- Helminths – nematodes and diagnostic methods in parasitology
- Life cycles, pathology, diagnosis; vectors / arthropods (ticks, lice, mosquitoes, etc.)

- Diagnostic methods: Sample collection & preservation; staining (Wright, Giemsa, etc.); concentration techniques for stool, blood; serological methods; molecular diagnostics (PCR, etc.)

UNIT 3: MYCOLOGY(FUNGI &FUNGAL DISEASES_- 10 hrs

- Introduction; classification of fungi; fungal cell structure and physiology; dimorphism; fungal nutrition and growth
- General properties of fungi
- Cultivation methods
- Laboratory methods of diagnosing fungal infection
- Superficial, cutaneous, subcutaneous, systemic, opportunistic fungi; examples: Candida, Aspergillus, Cryptococcus, Histoplasma, Blastomyces, Coccidioides
- Mycotoxins
- Opportunistic fungi in immunocompromised patients; fungal zoonoses; molecular diagnostics in mycology; molecular epidemiology;

UNIT 4: GENERAL VIROLOGY & VIRAL DIAGNOSTICS- 8hrs

- Nature of viruses: structure, classification (ICTV), replication cycles; virus–host interactions; pathogenesis; immune responses to viruses
- Virus Diagnostics: Sample collection, preservation; isolation & culture; cell culture, embryonated egg, animal models; detection techniques: microscopy, antigen / antibody assays (ELISA, immunofluorescence etc.), molecular methods (PCR, RT PCR), viral load assays
- Classfication and general properties of viruses - interferon, inclusion bodies

UNIT5: SYSTEMIC &CLINICAL VIROLOGY- 9 hrs

- Cultivation of viruses and laboratory diagnostic methods of viral diseases
- Pox virus, herpes virus, myxoviruses, picorna virus
- Rabies, arbo viruses, hepatitis, HIV, viruses causing gastroenteritis, prion diseases, miscellaneous viruses.

PARASITOLOGY, MYCOLOGY, VIROLOGY PRACTICAL

Parasitology Practical

15 Hours

1. Laboratory safety and specimen collection in parasitology.
2. Preparation and examination of saline and iodine wet mounts.
3. Stool examination for ova, cysts, larvae, and trophozoites.
4. Concentration techniques for intestinal parasites.

5. Identification of helminth ova and larvae.
6. Identification of protozoan parasites in stained smears.
7. Peripheral blood smear examination for malarial parasites.
8. Rapid diagnostic tests for malaria.
9. Demonstration of microfilaria in blood samples.
10. Identification of medically important parasites from charts/slides/models.
11. Quality control and biosafety practices in parasitology laboratory.
12. Clinical case discussion and report interpretation in parasitic infections.

Mycology Practical

15 Hours

1. Laboratory safety and specimen handling in mycology.
2. Direct microscopic examination using KOH mount.
3. Lactophenol cotton blue (LPCB) preparation and fungal identification.
4. Fungal culture techniques using SDA media.
5. Identification of yeasts and moulds based on colony morphology.
6. Gram staining for fungal elements.
7. Germ tube test for Candida species.
8. Slide culture technique for mould identification.
9. Demonstration of cryptococcal antigen testing/India ink preparation.
10. Antifungal susceptibility testing (demonstration).
11. Quality control procedures in mycology laboratory.
12. Clinical case interpretation of fungal infections.

Virology Practical

15 Hours

1. Biosafety practices in virology laboratory.
2. Collection, transport, and storage of viral specimens.
3. Preparation and handling of viral transport media.

4. Demonstration of ELISA for viral infections.
5. Rapid card tests for viral markers (HIV, HBsAg, HCV).
6. Demonstration of immunofluorescence techniques in virology.
7. Principles and demonstration of PCR in viral diagnosis.
8. Interpretation of viral serological tests.
9. Cell culture demonstration/video demonstration for virus isolation.
10. Quality assurance in virology laboratory.
11. Biomedical waste management in virology laboratory.
12. Clinical case discussion and interpretation of viral diagnostic reports.

Clinical laboratory posting/observation may be incorporated wherever feasible

RECOMMENDED TEXT BOOKS

• Prescott's Microbiology
• Ananthanarayan and Paniker's Textbook of Microbiology

APPLIED HISTOPATHOLOGY AND CYTOLOGY

L/T/P/C
2/-/2/3

Learning Outcomes

- Analyze tissue processing and staining techniques.
- Interpret histopathological findings.
- Evaluate cytological diagnostic methods.
- Apply immunohistochemistry techniques.

Learning Objectives

- Describe fixation and tissue processing.
- Explain staining techniques.
- Outline cytology methods.
- Discuss IHC and special techniques.

(30 hrs)

UNIT I: Basic Histotechniques (Fixation & Decalcification)- 7 hrs

- Histotechniques:

Introduction to histotechnology

- Fixation
- Decalcification
- Criteria of a good decalcification followed selection of tissue, fixation and decalcification, neutralization of acid and through washing.
- Various types pf decalcifying fluids: organic & inorganic acid, chelating agents, use of ion-exchange resigns and electrophoretic decalcification and treatment of hard tissues which are not calcified.
- Processing of various tissues for histological examination
- Dehydration, clearing, infiltration and routine timing schedule for manual or automatic tissue processing.
- Components & principles of various types of automatic tissue processors.

UNIT 2: EMBEDDING, SECTIONING & STAINING- 6 hrs

- Embedding – types of media
  • Microtomy – knives, sharpening, honing, stropping, types of microtomes
  • Routine staining – Hematoxylin & Eosin
  • Special stains (microorganisms, hemosiderin, lipids)

UNIT 3: ADVANCED HISTOTECHNIQUES& IMMUNOTECHNIQUES – 7 hrs

- Enzyme histochemistry and immunoenzyme techniques
- Immunohistochemistry and the various immune histochemical stains in the diagnosis of various disorders
- Immunofluorescence – principles and applications, FISH, tissue micro array, cryostat, frozen techniques.
- Tissues of special interest – nervous system, hard tissue.
- Miscellaneous cells
- Endocrine cells

UNIT 4: CYTOLOGY TECHNIQUES -5 hrs

- Cytology technique
- Liquid based cytology
- Cell block preparation
- Quantitative methods

UNIT 5: SPECIALIZED TECHNIQUES & DOCUMENTATION- 5 hrs

- Micro incineration
- Autoradiography
- Museum techniques

- Specimen photography and photomicrography

PRACTICALS: (60 hrs)

1. Tissue processing
2. Section cutting
3. H & E staining
4. Special stains
5. PAP staining
6. Cryostat
7. Frozen techniques
8. IHC

RECOMMENDED TEXT BOOKS

• Bancroft's theory and practice of histological techniques 8th edition
• Handbook of histopathological and histochemical techniques. C.F.A.Culling

Blood Banking and Immunohematology

Course Rationale: The course is designed for students to apply advanced immunohaematological principles. They can also independently execute donor screening, blood collection and preparation of blood components.

Learning outcome: At the end of the course the students can

- Apply advanced immunohematological principles in laboratory diagnostics.
- Demonstrate competency in antibody detection, identification, and complex serological problem solving.
- Execute donor screening, blood collection, and blood component preparation as per national regulatory standards.
- Evaluate and manage transfusion reactions and special transfusion scenarios.
- Ensure compliance with quality standards, biosafety, and legal regulations in blood banking.

UNIT-I **10 hours**

Advanced Immunohematologic Principles: Principles of Immunohematology, Genetics of ABO blood group system, their subgroups, RBC antigens and consecutive antibodies, Genetics of Rh Blood group and antibodies, Minor blood group systems, Bombay blood

group, ABO and Rh incompatibility, Hemolytic Disease of newborn and its management, Alloantibodies Vs auto antibodies, High-titer, low-avidity antibodies, Human leucocytic antigen

UNIT-II **8 hours**

Blood collection and donor selection criteria:

Donor Management:

Donor registration and screening, Phlebotomy in blood banks, blood storage, various anticoagulants used in blood bags, types of blood bags used in blood banks

Blood Collection & Processing:

Whole blood collection, Adverse reactions and their management, Blood transmitted disease and their testing, Labelling, storage, and transportation of blood

UNIT-III **8 hours**

Serologic Techniques and Problem Solving:

Blood compatibility tests, Antibody screening and identification, DAT and IAT optimization, Enzyme treatment, adsorption/elution techniques,

UNIT-IV **7 hours**

Component preparation and storage:

Apheresis vs whole blood donation, Component separation techniques, Storage, shelf-life, and transportation protocols, Hemovigilance in component therapy

UNIT- V **5 hours**

Molecular Applications in Immunohematology:

Molecular genotyping of blood groups**,** Discrepancy resolution between serology and molecular testing**,** Role in prenatal and donor typing

UNIT- VI **10 hours**

Regulatory, QC, and Ethics in Blood Banks:

NABH, NACO, FDA, CDSCO guidelines, Quality management system (QMS), Inventory management, Incident reporting & blood bank audits, Regulatory framework: Drugs and Cosmetics Act, licensing of blood banks, GMP, GLP, SOPs, and NABH/NABL accreditation, Standard operating procedures (SOPs), External quality assessment (EQA), Regulatory compliance (FDA, NABL, DGHS), Safety and biosafety in blood banks

Blood Banking and Immunohematology Practical

30 hours

1. Preparation of Red Cell Suspensions and daily Quality Control of ABO & Rh D Preparation of Papain cystein and Blood Group Regents
2. Performing ABO Blood Group
3. Performing Antigen Typing – Indirect
4. Performing Direct Anti-Globulin Test
5. Performing Anti-globulin Cross-Match
6. Study of Labelling of Blood Bags and Blood Components
7. Study of Storage of Blood and Blood Components
8. Study of Inventory of Blood Bags and Blood Components
9. Study of Selection of units for cross matching
10. Bilirubin Testing
11. Disposal of Reactive Bags, its components, non-reactive buffy coat units
12. ELISA/ Rapid card based identification of blood borne infections

***** Clinical postings should be incorporated wherever possible**

Suggested Readings:

1. Lee, G. R., Foerster, J., Lukens, J., Paraskevas, F., Greer, J. P., & Rodgers, G. M. (1999). Wintrobe's clinical hematology 10th. *Bethseda, Maryland: Lippincort Williams and Wilkins.*
2. Klatt, E. C. (2014). *Robbins and Cotran atlas of pathology*. Elsevier Health Sciences.
3. Firkin, F., Chesterman, C., Rush, B., & Pennigton, D. (2008). *De Gruchy's Clinical haematology in medical Practice*. John Wiley & Sons.
4. Bain, B. J., Bates, I., & Laffan, M. A. (2016). *Dacie and Lewis Practical Haematology E-Book: Dacie and Lewis Practical Haematology E-Book*. Elsevier Health Sciences.

CLINICAL POSTINGS - III

Learning Outcomes

- Perform independent laboratory procedures.
- Interpret clinical laboratory data.
- Apply quality assurance practices.
- Demonstrate professional competency.

Learning Objectives

- Conduct diagnostic tests independently.

- Follow advanced lab protocols.
- Maintain quality standards.
- Document and report findings.

(210 hrs)

Students should be posted in,

1. Biochemistry lab.
2. Pathology lab and Histopathology lab
3. Molecular biology lab
4. Microbiology lab.

SEMESTER IV

S.NO	SUBJECT CODE	SUBJECT	L	T	P	C	Max. Marks		
							INT	EXT	TOTAL
1		Thesis / Research Project	-	-	6	6	40	60	100
2		Cancer epidemiology and Digital Pathology	2	-	-	2	40	60	100
3		Haemostatic and Haematological Disorders	3	-	-	3	40	60	100
4		Immunology and Immunodiagnostics	3	-	1	4	40	60	100
5		Enzymology & Nutrition	2	-	-	2	40	60	100
6		Haemostatic and Haematological Disorders - practical	-	-	2	2	40	60	100

7		Swayam: Basic course in biomedical research							
TOTAL			**10**		**9**	**19**	**240**	**360**	**600**

THESIS/RESEARCH PROJECT

L/T/P/C
-/-/6/6

Learning Outcomes

- Design and conduct independent research.
- Analyze and interpret research data.
- Present scientific findings effectively.
- Contribute to evidence-based practice.

Learning Objectives

- Formulate research questions.
- Apply research methodology.
- Perform data analysis.
- Prepare dissertation.

(120 hrs)

In project/thesis, the students should be able to:

- Independently conduct research
- Critically analyze findings with scientific methodology
- Contribute to evidence-based practice and innovations

Cancer Epidemiology and Digital Pathology

Course outcome: To equip students with an integrated understanding of cancer burden, population-level trends, risk profiling, and cutting-edge digital tools used in cancer diagnostics and reporting.

Learning Outcome: At the end of the course students will be able to

- Interpret cancer trends using epidemiological tools and global databases
- Correlate tumor biology with diagnostic and prognostic markers
- Demonstrate understanding of digital pathology systems and workflow
- Apply integrated epidemiological and digital pathology tools to cancer diagnostics

- Critically assess ethical, technical, and translational aspects of digital pathology

UNIT-I **6 hours**

Principles of Cancer Epidemiology: Definitions, concepts, and scope of cancer epidemiology, Cancer classification, Risk factors: genetic, environmental, lifestyle, occupational, Descriptive vs. analytical epidemiological studies, Cancer registries, cohort studies, and surveillance systems

UNIT-II **6 hours**

Global and Regional Cancer Trends: GLOBOCAN, WHO, and IARC databases and tools; Common cancers by geography, gender, and age;
Cancer disparities: socioeconomic and environmental determinants;
Public health policies, screening guidelines (e.g., HPV, breast, colorectal); Epidemiology of emerging cancers and rare tumors

UNIT-III **6 hours**

Tumor Biology and Molecular Basis of Cancer: Oncogenes, tumor suppressor genes, and hallmarks of cancer, Cancer immunology: immune escape, tumour microenvironment, Pathways of metastasis and angiogenesis, Molecular diagnostics: PCR, FISH, NGS, liquid biopsy, Biomarkers in cancer diagnosis, prognosis, and therapy monitoring

UNIT-IV **6 hours**

Digital Pathology Tools and Workflow: Fundamentals of digital slide scanning and virtual microscopy, Image analysis and whole-slide imaging (WSI) systems, AI and machine learning algorithms in pathology, Quality assurance, interoperability, and regulatory frameworks, Role of digital pathology in telepathology, consultation, and education

UNIT- V **6 hours**

Applications in Diagnostics, Screening, and Research: Integration of epidemiological data with digital histopathology, Use of AI in cancer grading and biomarker quantification, Personalized medicine and predictive pathology, Digital pathology in multicenter trials, biobanks, and data mining, Ethical and data privacy considerations in digital pathology

Haemostatic and Haematological Disorders

Course Rationale

This course equips learners with comprehensive knowledge of hematological and hemostatic disorders, integrating normal physiology, pathological mechanisms, diagnostic hematology,

coagulation studies, and laboratory practices. It emphasizes interpretation of hematological abnormalities, bleeding and thrombotic disorders, reflex diagnostics, quality assurance, and automation in modern hematology laboratories.

Learning Outcomes

At the end of the course, the learner will be able to:

1. Explain hematopoiesis, normal hemostatic mechanisms, and coagulation pathways.
2. Classify and interpret hematological, bleeding, and thrombotic disorders using clinical and laboratory findings.
3. Perform and interpret routine and special hematological and coagulation investigations.
4. Apply reflex testing algorithms and quality control practices in hematology laboratories.
5. Integrate automation and recent advances in hematology and coagulation diagnostics into laboratory practice.

UNIT I: Hematopoiesis and Hemostasis Physiology

8 Hours

- Hematopoiesis and blood cell development
- Structure and functions of blood cells
- Normal hemostatic sequence: vascular constriction, platelet plug formation, coagulation cascade, fibrinolysis
- Role of endothelium, platelets, coagulation proteins
- Natural anticoagulants: Protein C, Protein S, Antithrombin III
- Overview of intrinsic, extrinsic, and common coagulation pathways

UNIT II: Coagulation Factors and Hematological Disorders

8 Hours

- Coagulation factors I–XIII: nomenclature, synthesis, functions, vitamin K dependency
- Activation pathways and coagulation mechanisms
- Anemias: classification and laboratory diagnosis
- Leukocyte disorders: leukocytosis, leukopenia, leukemia
- Platelet disorders and thrombocytopenia
- Peripheral smear interpretation and diagnostic significance

UNIT III: Primary and Secondary Hemostatic Disorders

8 Hours

- Platelet function defects and qualitative platelet disorders
- Immune thrombocytopenic purpura (ITP)
- Bernard–Soulier syndrome and Glanzmann thrombasthenia
- Hemophilia A and B
- von Willebrand disease: types and laboratory diagnosis
- PT/APTT prolongation patterns and factor deficiencies
- Bleeding time, clotting time, platelet aggregation studies

UNIT IV: Thrombotic Disorders and Advanced Coagulation Testing

7 Hours

- Disseminated intravascular coagulation (DIC)
- Thrombotic thrombocytopenic purpura (TTP)
- Hemolytic uremic syndrome (HUS)
- Acquired coagulation inhibitors and circulating anticoagulants
- D-dimer and fibrin degradation products
- Mixing studies and lupus anticoagulant testing
- TEG/ROTEM and platelet function analyzers

UNIT V: Laboratory Diagnosis, Automation, and Quality Management

7 Hours

- Complete Blood Count (CBC) and hematology analyzer principles
- PT, APTT, TT, clot retraction, factor assays, vWF antigen and activity testing
- Reflex testing and algorithmic diagnosis in hematology and coagulation
- Laboratory automation and point-of-care testing
- Quality control and quality management in hematology laboratories
- Recent advances in coagulation diagnostics and molecular hematology

- International guidelines (ASH/ICSH/WHO/ISTH)

PRACTICALS

Haemostatic and Haematological Disorders

60 Hours

1. Perform laboratory safety precautions and biomedical waste disposal.
2. Collection, transport, processing, and storage of blood samples for hematological and coagulation studies.
3. Complete Blood Count (CBC) and hematology analyzer operation.
4. Peripheral smear preparation, staining, and interpretation.
5. Platelet count and identification of platelet abnormalities.
6. Bleeding Time (BT) and Clotting Time (CT).
7. Prothrombin Time (PT), Activated Partial Thromboplastin Time (APTT), and Thrombin Time (TT).
8. Mixing studies and interpretation of coagulation abnormalities.
9. Coagulation factor assays and dilution studies.
10. D-Dimer and FDP estimation.
11. vWF antigen and activity estimation.
12. Platelet aggregation studies and platelet function analysis.
13. ROTEM/TEG simulation and interpretation.
14. Hematology laboratory automation, calibration, and QC documentation.
15. Integrated case analysis, diagnostic algorithm preparation, and report writing.
16. Review and interpretation of WHO/ISTH guidelines.
17. Clinical laboratory observation/rotation wherever feasible.

Suggested Readings

1. Clinical Laboratory Hematology – McKenzie SB, Williams JL. Pearson Education.
2. Wintrobe's Clinical Hematology – Lippincott Williams & Wilkins.
3. Dacie and Lewis Practical Haematology – Elsevier Health Sciences.
4. Henry’s Clinical Diagnosis and Management by Laboratory Methods – Elsevier.

5. Textbook of Medical Laboratory Technology – Jaypee Brothers Publishers.
6. Color Atlas of Clinical Hematology – Elsevier.

Immunology and Immunodiagnostics

Course Rationale: This course enables students in medical laboratory science to equip students with an in-depth understanding of advanced immunological concepts and diagnostic strategies relevant to infectious disease microbiology. It emphasises molecular mechanisms, immune dysfunctions, and clinical applications of immunodiagnostic technologies.

Learning Objectives:

- Describe fundamental immune mechanisms involved in microbial defence, inflammation, and hypersensitivity.
- Interpret antigen presentation and MHC associations in infection susceptibility, autoimmunity, and transplant contexts.
- Evaluate immune dysfunctions including immunodeficiencies and autoimmune disorders with reference to microbial interactions.
- Apply principles of vaccine design and immune modulation to microbial pathogens and emerging clinical scenarios.

UNIT-I — 6 hours

Overview of Immunity: Evolution of immunity; innate and adaptive immunity; immunological memory; inflammation mechanisms; immune regulation and tolerance; relevance in infection detection and host defense mechanisms.
Immune Organs and Cells: Structure and functions of primary and secondary lymphoid organs; influence of microbiota on lymphoid development. Classification and roles of immune cells including T lymphocytes, B lymphocytes, natural killer cells, and dendritic cells. Mechanisms of antigen processing and presentation, structural and functional diversity of immunoglobulin molecules, and the production and clinical applications of monoclonal antibodies.

UNIT-II — 4 hours

Complement System & Effector Mechanisms: Overview of activation pathways—classical, alternative, and lectin—and their regulatory mechanisms. Functional roles in host defense, microbial clearance (e.g. *Neisseria*, *Candida*), inflammation, and autoimmune pathology. Diagnostic applications including CH50 and AH50 assays, and relevance in clinical Immunodiagnostics.

UNIT-III **6 hours**

Immune Response: clonal selection theory and its significance in adaptive immune responses; differences between cell-mediated and humoral immunity.
Major Histocompatibility Complex & Antigen Presentation: structure, genetic polymorphism, and expression patterns of Major Histocompatibility Complex molecules; their role in presenting processed antigens to lymphocytes; disease associations involving MHC alleles; and their clinical relevance in infection susceptibility, autoimmune conditions and in organ transplantation.

UNIT-IV **6 hours**

Lymphocyte Biology: Maturation, activation, differentiation of B lymphocytes and T lymphocytes; structural diversity of T-cell receptors; lymphocyte trafficking and homing mechanisms.
Cytokines & Immune Modulators: Classification and roles of cytokines; therapeutic applications; cytokine storm phenomena; kinin cascade and immune modulation

UNIT- V **4 hours**

Hypersensitivity & Immune Dysregulation: the classification and pathophysiological mechanisms of hypersensitivity reactions (Type I to Type IV) and their clinical implications in transfusion reactions, allergic disorders, and autoimmune conditions; laboratory strategies to identify hypersensitivity responses.

UNIT- VI **6 hours**

Immunodeficiency Syndromes: Primary immunodeficiencies; molecular mechanisms; diagnostic approaches; secondary infections post-immunosuppression; microbial vulnerability; relevant diagnostics pathways.
Autoimmunity & Tolerance: the mechanisms of central and peripheral immune tolerance; microbial mimicry in autoimmune diseases (*Campylobacter* in Guillain-Barré); immunological errors leading to autoimmune diseases such as systemic lupus erythematosus and rheumatoid arthritis; diagnostic markers.

UNIT- VII **5 hours**

Transplantation Immunology: Immune recognition in allografts and xenografts; pathways of rejection; pharmacological and immunological strategies for immunosuppression; significance of human leukocyte antigen matching; and influence of microbial factors on graft survival.
Tumor Immunology: the identification and roles of tumor-associated antigens; immune evasion by pathogens; mechanisms of immunosurveillance.

UNIT- VIII **3 hours**

Immunogenetics & Epigenetics: genetic determinants of immune variability and disease susceptibility; HLA associations with microbial and autoimmune diseases; epigenetic regulation of immune responses; clinical application of immunogenetics and epigenetics in diagnostics and predictive medicine.

UNIT- IX 2 hours

Systems Immunology & Immune Profiling: High-throughput immunological assays; transcriptomic & proteomic responses to pathogens; microbiome-immune interactions; bioinformatics for infection tracking.

UNIT- X 3 hours

Vaccine Design and Immunodiagnostics: Foundational principles of vaccine design and administration, including microbial antigen selection, immune activation, and immunological memory formation.
Immunodiagnostic techniques ELISA, flow cytometry, and lateral flow assays for detecting microbial infections.
Advanced immunotherapies -Chimeric Antigen Receptor T-cell therapy and immune checkpoint blockade therapy and their diagnostic relevance in infection-linked immune modulation.

Immunology and Immunodiagnostics Practical

- Sample Collection & Handling - Blood, serum, and tissue sampling for immunological assays; biosafety and ethical protocols
- Peripheral Blood Smear Interpretation -Identification of major immune cells and lymphoid structures related to infection defense
- Immunoassays -Agglutination, flocculation, ELISA, WIDAL, CRP, Coombs, ASLO, and RPR tests
- Immunoblotting & Lateral Flow Techniques -Interpretation of infectious disease strips (e.g. malaria, HIV rapid cards)
- Antibody Titer Estimation -Dilution-based methods for semi-quantitative antibody analysis
- Flow Cytometry -Immunophenotyping of immune cells and gating analysis
- Immunofluorescence (Direct & Indirect)-Microscopic detection of immune markers for diagnostic applications
- Autoimmune Marker Detection -Rheumatoid Factor, Anti-CCP, and Antinuclear Antibody (ANA) assays
- Biosafety & Quality Control in Immunodiagnostics -Practices for accuracy, reproducibility, and documentation in clinical labs
- Clinical Case Analysis -Case-based interpretation of immune dysfunction in infectious disease contexts

***Clinical laboratory rotation/observation can be incorporated wherever possible**

Suggested Reading:

1. Punt, J., Stranford, S., Jones, P., Owen, J.A. – Kuby Immunology, W.H. Freeman

2. Parslow, T.G., Stites, D.P., Terr, A.I. – Medical Immunology, McGraw Hill
3. Delves, P.J., Martin, S.J., Burton, D.R., Roitt, I.M. – Roitt's Essential Immunology, Wiley-Blackwell
4. Kumar, V., Abbas, A.K., Aster, J.C. – Robbins Basic Pathology, Elsevier
5. Gangal, S., Sontakke, S. – Text Sontakke, S. – Textbook of Basic andbook of Basic and Clinical Immunology, Universities Press (India) Pvt. Ltd.
6. Subhash Chandra Parija – *Textbook of Microbiology and Immunology*, Elsevier
7. S.K. Gupta – *Essentials of Immunology*, Jaypee Brothers Medical Publishers

Enzymology and Nutrition

Course Rationale

This course provides fundamental knowledge of enzyme structure, mechanism, kinetics, clinical applications, and the biochemical importance of nutrition, vitamins, and minerals in health and disease. It integrates enzymology with clinical nutrition and metabolic regulation relevant to laboratory and healthcare sciences.

Learning Outcomes

At the end of the course, students will be able to:

1. Explain the structure, classification, and functions of enzymes.
2. Interpret enzyme kinetics and mechanisms of enzyme inhibition.
3. Describe the biochemical roles, sources, deficiencies, and toxicities of vitamins and minerals.
4. Explain the role of nutrition in metabolism, growth, immunity, and disease prevention.
5. Apply principles of clinical enzymology and nutritional assessment in healthcare practice.

UNIT I: Introduction to Enzymes and Mechanism of Action

6 Hours

- Nomenclature, classification, and characteristics of enzymes
- Enzyme specificity
- Cofactors, coenzymes, prosthetic groups, activators, and inhibitors
- Active site and enzyme-substrate complex
- Isoenzymes, metalloenzymes, monomeric and oligomeric enzymes

- Units of enzyme activity (IU, Katal), specific activity, enzyme turnover
- Mechanism of enzyme action
- Induced fit hypothesis and lock-and-key concept
- Acid-base catalysis, covalent catalysis, role of metal ions
- Feedback inhibition and regulation of enzyme activity

UNIT II: Enzyme Kinetics and Clinical Enzymology

7 Hours

- Michaelis-Menten equation and significance of Km and Vmax
- Factors affecting enzyme activity: pH, temperature, substrate concentration
- Allosteric enzymes and substrate inhibition
- Reversible and irreversible enzyme inhibition
- Competitive, non-competitive, uncompetitive, and mixed inhibition
- Applications of enzymes in medicine and biotechnology
- Clinical enzymology and diagnostic importance of enzymes
- Clinical significance of alkaline phosphatase, acid phosphatase, SGOT, SGPT, LDH, CPK, AST, ALT, creatine kinase
- Therapeutic enzymes: streptokinase and asparaginase

UNIT III: Nutrition and Nutritional Assessment

7 Hours

- Caloric values of foods, basal metabolic rate (BMR), respiratory quotient
- Energy requirements and balanced diet
- Role of carbohydrates, lipids, proteins, and amino acids in nutrition
- Nitrogen balance and protein-energy malnutrition
- Glycemic index and nutritional assessment
- Diet planning in pregnancy and lactation
- Nutrition in diabetes, obesity, renal failure, cardiovascular disease, and cancer

UNIT IV: Vitamins, Minerals, and Nutritional Genomics

10 Hours

- Vitamins: classification, sources, biochemical functions, deficiency and toxicity manifestations of fat-soluble and water-soluble vitamins
- Minerals: classification, sources, biochemical functions, deficiency and toxicity manifestations of macro and micro minerals
- Introduction to nutrigenetics and nutrigenomics
- Role of genes in metabolism and nutrient utilization
- Omics technologies in nutrigenomics

Suggested Readings

1. Fundamentals of Enzymology – Oxford University Press.
2. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry – Horwood Publishing.
3. Textbook of Biochemistry with Clinical Correlations – Wiley.
4. Modern Nutrition in Health and Disease – Wolters Kluwer Health.